Issued December 16, 1916.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA, AGRICULTURAL EXPERIMENT STATION, THOMAS F. HUNT, DIRECTOR; CHARLES F. SHAW, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF THE UKIAH AREA, CALIFORNIA.

BY

E. B. WATSON, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN CHARGE, AND R. L. PENDLETON, OF THE UNIVERSITY OF CALIFORNIA.

MACY H. LAPHAM, INSPECTOR, WESTERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1914.]

WASHINGTON:
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1916.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., April 14, 1916.

SIR: In the extension of the soil survey in the State of California during the field season of 1914 a survey was made of the Ukiah area. This work was done in cooperation with the University of California Agricultural Experiment Station, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this area and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1914, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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SOIL SURVEY OF THE UKIAH AREA, CALIFORNIA.

By E. B. WATSON, of the U. S. Department of Agriculture, in Charge, and R. L. PENDLETON, of the University of California.

DESCRIPTION OF THE AREA.

The Ukiah area embraces the arable valleys of the Russian River drainage system in Mendocino County, Cal., together with a portion of the Coast Range Mountains adjacent thereto. It comprises an area of 303 square miles, or 193,920 acres, in the southeastern part of Mendocino County, and extends from the southern boundary of the county northward to the limits of the agricultural land in the Russian River drainage basin. The area is about 36 miles long and from 7 to 12 miles wide.

The base map used in plotting the soils was constructed by plane-table traverse by the field party, no published map suitable for the purpose being available.

FIG. 1.—Sketch map showing location of the Ukiah area, California.

The Coast Ranges of northern California occupy a belt 50 to 70 miles wide, extending from the coast eastward to the Sacramento Valley. This region is composed of a series of roughly parallel ridges and valleys, or basins, which in the southern part of Mendocino County have a trend nearly parallel to the coast. One of these large valley basins is drained by the upper part of the Russian River and constitutes the principal part of the survey. Within this basin are located several arable regions separated by rougher hilly areas. Each of the arable areas has a distinctive name. As an aid to a clear understanding of their location and relationship, the sketch map (fig. 2) is given. This shows the different arable valleys within the survey, including the large valley or basin, which was partly or completely filled at an early date and out of which the Redwood, Calpella, Coyotte, and Ukiah Valleys subsequently were formed. About 5 miles east of the northern part of this main trough or basin is a short and broad depression, Potter Valley, the drainage of which crosses the intervening ridge and unites with the main Russian River drainage. This valley is included in the survey and is

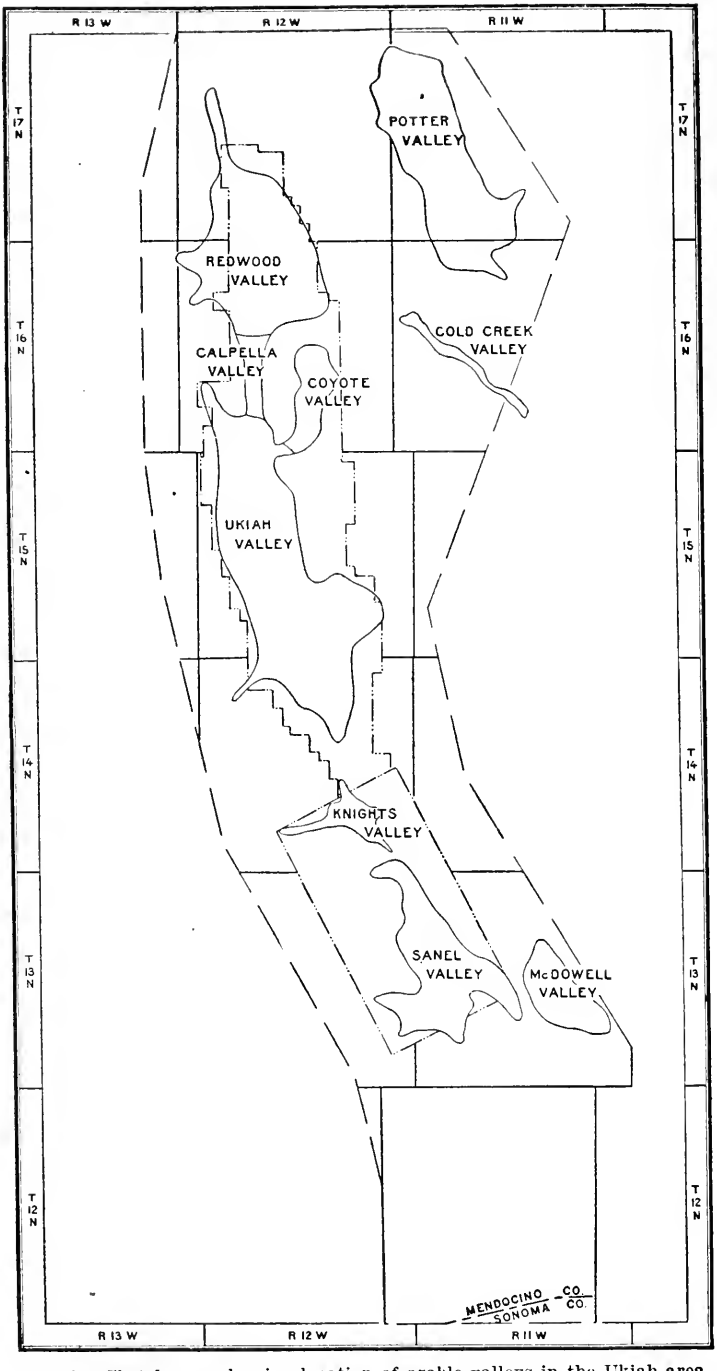

FIG. 2.—Sketch map showing location of arable valleys in the Ukiah area.

indicated on the sketch map. These are the areas usually known as the upper Russian River valleys, and outside of these comparatively level areas and three small valleys in the southern part of the area, the drainage basin of the Russian River is untillable.

The elevation of the floors of the several valleys varies from about 475 feet at the lower end of Sanel Valley in the southern part of the survey to 870 feet in the Laughlin Flat in Redwood Valley, and to about 1,000 feet in the upper part of Potter Valley.

The gradient of the Russian River varies considerably in different parts of its course. Calculations made from the profile of the Northwestern Pacific Railroad indicate that the gradient through the gorge at the lower end of the area surveyed is about 15 feet per mile. Just above this, or from the lower end of Sanel Valley up to Calpella, at the junction of Forsythe Creek and the Russian River, the gradient varies from 7 to 10 feet per mile. The gradient of the East Fork of Russian River through Potter Valley is comparatively low, but that through the gorge leading from the valley probably is twice as great as in the valley.

The arable valleys are mainly from 1 mile to 3 miles wide. They are not continuous, but are separated by intervening hills and ridges, which are traversed in places by narrow connecting stream gorges.

From these nearly level valley floors the hills rise rather abruptly to elevations of 1,500 to 2,500 feet above them, or from 2,000 to 3,000 feet above sea level. Mount Sanhedrin, 6,200 feet high, about 10 miles northeast of Potter Valley, is the highest mountain in the region. Duncan Peak, which is a conspicuous feature of the landscape near Hopland, is 2,700 feet high. The watersheds on both sides of the drainage basin are about 2,500 to 3,000 feet high, with passes through them about 1,000 feet lower than the summits. These hills for the most part are rounded, and the native vegetation varies from grass with scattered trees to a heavy covering of chaparral and a thick growth of trees on sheltered slopes. Springs abound in the hills. Some of these carry lime in solution and have made small deposits of travertine or of impure limestone; others contain iron and other minerals, and some are hot. Many of the springs are reputed to be medicinal, and health resorts have developed about them.

The drainage of the entire area is carried by the Russian River, which flows southward through the center of the area, with important tributaries from both the east and west. The drainage of the hills is very well established, and drainage channels of relatively high gradients reach into every part of the hilly areas. The drainage of the valley floors is generally complete, but there are a few places where it is imperfect. The streams of the region are mainly perennial in the sections underlain by consolidated rocks, but in the alluvial valleys during the summer they sink into the gravels and disappear.

The several arable valleys differ from each other in their physical characteristics, which have influenced their settlement and development, so that they can best be described separately.

Potter Valley.—Potter Valley lies in the extreme northeastern part of the Ukiah area and is drained by the East Fork of the Russian River. No very large streams enter it. The valley is about 7 miles long and 2 miles wide. It is characterized by a broad, level floor, which seems to be a recently drained basin, merging into low alluvial fans having a gentle slope up to the surrounding hills (Pl. I). A part of the floor of the valley has until recently been poorly drained, and the effect of this condition is seen in the character of the soil. Remnants of old valley-filling material, rising from 5 to 20 feet above the floor of the valley, occur in a number of places in the southern half of the valley, and remnants of a still older valley filling, from 100 to 400 feet high, border the valley on the west, but there are no such remnants on the east. In the southeastern extremity of the valley, however, where Mewhinney Creek enters, there are high remnants of old valley filling.

The first settlers found the valley parklike, with an open cover, including scattered trees of valley oak and small groves of various trees covering perhaps one-third of the area. They could plow many fields without the trouble of clearing. Although the soils are productive, markets have been more or less inaccessible, and as a result stock raising became the chief form of agriculture. The stock ranged in the hills and in the stubble fields after harvest, the hay and grain produced being used to fatten the animals for market. This type of farming has continued to the present time.

The cause of the thin covering of trees in Potter Valley, while Redwood Valley just across the ridge to the west was densely wooded, is a matter of interest. The most probable explanation is that there is less rainfall than in Redwood Valley. It is shown in the discussion of climate that there are variations in the rainfall in different parts of the area, and the fact that Redwood Valley is about 6 miles nearer the coast and has a pronounced gap in its western wall (Forsythe Creek Valley) through which the ocean winds may blow, while Potter Valley has a relatively high ridge to the west of it, probably accounts for the difference in precipitation. The more open cover was, no doubt, one of the main reasons for this valley being settled much sooner and more completely than Redwood Valley. The large proportion of recent alluvial soils and the distance from markets have been important factors in determining the type of agriculture followed.

Redwood Valley.—Redwood Valley is the most northern of the valleys drained by the central fork of the Russian River. It is roughly triangular in shape, about 4 miles wide and 5 miles long.

with its base lying to the south and the apex to the north, where the Russian River enters the valley. Forsythe Creek, which enters from the west, carries much more water than the central stream. Redwood Valley is characterized by a narrow river flood plain and a broad expanse of old alluvial valley filling or river terrace from 10 to 75 feet above the flood plain. It is bounded on the south and southeast by high hills of old unconsolidated valley-filling material from 400 to 600 feet high. There are no high areas of old valley-filling materials at the north end of the valley.

The greater part of Redwood Valley originally was heavily forested with a growth of oak, fir, and manzanita. Apparently there was some open country in the northern part. The dense growth of timber retarded settlement. The bottoms were found to be very productive and were cleared at an early date. The bench lands constituting most of the valley were not so well suited to grain production, the only type of farming attempted. The belief became fixed that the bench lands were poor, and the dense covering made the cost of clearing high. These factors have materially modified the development of this valley, as compared with that of Potter Valley and Ukiah Valley. These valleys were settled about the same time, but at present Potter Valley and Ukiah Valley are almost entirely cleared and farmed, while a large part of Redwood Valley is forested. Interest in the possibilities of growing fruit on the bench lands is now being manifested. There are no commercial orchards of bearing age in the valley, but home orchards indicate the suitability of the land for fruit production.

Cold Creek Valley.—Cold Creek Valley is small and not very important agriculturally. It is located a few miles south of Potter Valley. Cold Creek is a tributary of the East Fork of the Russian River. The part of Cold Creek Valley included in this area is about one-eighth mile wide and 4 miles long. The valley extends beyond the area surveyed.

The valley of Cold Creek is interesting because it evidently belongs to a middle-aged stream which is a tributary to a very youthful stream. The East Fork of the Russian River flows with a high gradient through a V-shaped gorge. It has a youthful topography. Cold Creek, a tributary, flows at a much lower gradient, as is evidenced by the size of the stones in its bed, and has a distinct flood plain and also a terrace. It has attained middle age.

Holway[1] has established the fact that Cold Creek has lost a large tributary, Scott Creek, by a large landslide which diverted the waters to Clear Lake and thence to the Sacramento River. This probably has a bearing on the anomalous condition just noted.

[1] Holway, "The Russian River," Univ. of Cal. Pub. in Geog., vol. 1, No. 1.

Calpella Valley.—Calpella Valley lies between the two large remnants of old valley filling just south of Redwood Valley. This is a small valley, barely one-half mile wide, and 2 miles long. It comprises a very narrow flood plain, and above this a series of terraces which blend into each other and are bounded on both the east and the west by the high eroded early valley filling.

Although this valley was settled at an early date and was on the main thoroughfare for travel north and south, much of it is uncleared and undeveloped. It has had about the same agricultural history as Redwood Valley.

Coyote Valley.—This valley lies east of Calpella Valley across a high ridge of early alluvial-fan or old valley-filling material (Pl. II, fig. 1). It evidently is a recent valley carved out of the old valley-filling deposits by the East Fork of the Russian River, which flows through it. It is hardly 1 mide wide and is 2½ miles long. The soils occupy mainly a low terrace, modified in places by recent fan deposits, and are quite productive.

Ukiah Valley.—The Ukiah Valley is the most important of the arable valleys in the area. It lies south of Calpella and Coyote Valleys, near the center of the area surveyed. It is from 2 to 4 miles wide and about 10 miles long. The Russian River flows through its entire length, and several fairly large streams enter from both sides. It is characterized by a wide flood plain of the Russian River, by low, fertile recent alluvial fans, formed by several of the smaller lateral streams, and by low bench lands bordering the present flood plains and having a topography well suited to cultivation. This valley is intermediate in physiographic features between Potter Valley and Redwood Valley. Its forest covering was also probably intermediate in density.

Its productive soils, found in large bodies, and its location are factors which have encouraged development. Along Robertson Creek, which enters the southern part of the valley from the west, there is a small extension, the characteristics of which are much the same as those of the main valley.

Knights Valley.—Knights Valley is south of Ukiah Valley, and is separated from it by a low ridge covered by residual soils. This is a small valley with its axis lying oblique to that of the main valleys. It is about 3 miles long in its greatest extension, very narrow at its upper end, and 1½ miles wide at its lower end.

The drainage of this valley is carried by McNab Creek, which unites with the Russian River about a mile below the valley. The upper or western extension of the valley has a good slope, but the lower part is basinlike. The topography in this part is level and the soils are heavy, indicating deposition from quiet waters.

Sanel Valley.—South of Knights Valley is the Sanel Valley, which is quite irregular in outline. It is about 5 miles long and 1 mile wide, with a small side valley at the northern end extending westward from Largo, a larger side valley at the southern end extending westward, and a large extension on the east side. This valley is characterized by a wide flood plain and relatively small alluvial fans and a relatively large deposit of old valley filling in the southern part. The soils are very productive, and the large area of smooth flood plains has encouraged its development.

McDowell Valley.—McDowell Valley is a small valley lying east of Sanel Valley across a narrow ridge. This valley is about 2½ miles long and 1 mile wide. It is narrower at the north, widening out somewhat toward the south. McDowell Creek carries its drainage westward through the narrow ridge into the Russian River. McDowell Valley differs from the other valleys in the area in having no flood plain along the stream which drains it, the valley floor lying well above the bed of the stream and about on a level with the lowest part of the inclosing rim. Apparently the depression was filled to the rim, and later the stream cut down the outlet, but it has not yet succeeded in taking out any considerable amount of the original valley filling. The gorge has been eroded 60 to 75 feet below the valley floor. The valley apparently was largely forested originally, and considerable timber remains in places. A large part has been cleared. The soil is fairly productive, comparing very favorably with the bench land of Ukiah and Redwood Valleys.

There is one very small valley, not indicated on the sketch map, on a side stream which enters the gorge of the Russian River at Echo. The soils of this valley are derived from flood-plain and low alluvial-fan materials and are very productive.

Before the advent of the white man the Ukiah area was inhabited by the Pomo Indians. These were peaceful, domestic Indians, who derived their living from hunting, fishing, and gathering acorns and wild fruits. Apparently very little of the land was cultivated. Between 1850 and 1855 a few settlers located in Ukiah Valley and Potter Valley. From 1855 to 1860 settlement was quite rapid, and Mendocino County was organized in 1859, with Ukiah as the county seat. The centers of settlement were Sanel Valley, Ukiah Valley, and Potter Valley, which seem to have been settled and developed at the same time. Since about 1860 the development of the region has been gradual.

About 75 per cent of the early settlers came from Southern and Central States, and the remainder from other parts of the United States and from foreign countries. The Indians have decreased in number until only a few small settlements remain, scattered throughout the area. The white population has continued predominantly

Anglo-Saxon. A few Italians and Swiss have settled in the region in the last 10 years and are engaged mainly in grape growing. There are but few Chinese and Japanese, and they are mainly laborers. The rural population is principally confined to the level valleys. The population of the foothills is very sparse. The three political townships of Potter Valley, Ukiah, and Sanel were given a population of 6,587 in the last census. These townships are nearly identical with the area surveyed.

The area is traversed by the Northwestern Pacific Railroad, which follows approximately the course of the Russian River from the southern boundary of the area to Redwood Valley Station, in the northern part. Here it turns to the northwest, and crosses the divide to Willits and Eureka. To the south this railroad gives connections with San Francisco.

A State highway is being built approximately parallel to the railroad, and is nearing completion. This has a solid roadbed of easy grade, making travel easy at all times of the year. In addition, there is a good system of roads reaching all the agricultural areas, and means of communication are as good as the nature of the country will permit.

Ukiah is the principal town in the area. It is situated on the railroad in the Ukiah Valley. Its population is reported in the 1910 census as 2,136. Ukiah is the business center of the valley and the shipping point for the ranches back in the hills for many miles. A number of stages operate between this point and various towns and pleasure resorts in the Coast Range. The small town of Potter Valley is the trading center of the valley of the same name. There is no railroad in this valley. Calpella is a small town in the Calpella Valley. Hopland is located near the center of Sanel Valley on the railroad. It has grown up since the railroad was constructed. Old Hopland, 1 mile to the east across the river, was the business center of the valley during the days of the toll roads. Hopland has a population of about 200 people, and Old Hopland about 100. Echo, Cummiskey, Pieta, Fountain, Largo, Henry, El Roble, Redwood Valley, and Laughlin are shipping points on the railroad.

All the grain and hay produced are sold within the area. The live stock, hops, and fruit are mainly shipped south to the bay region, but some is sold in the lumbering towns to the north.

CLIMATE.

The climate of the Ukiah area resembles that of the Great Interior Valley of California in that it has a rainy season of moderate temperature and a dry season with high temperatures, but it differs in that the rainfall is greater and the temperature range is less. It is

intermediate in climate as well as in position between the Interior Valley and the coast region of Mendocino County, which has a still greater rainfall and cooler summers. Its climate is very similar to that of the neighboring valleys in the Coast Range.

The rainy season occurs in the winter months, from the first of November to the last of April. The five months from May to September, inclusive, constitute the summer or dry season. The mean annual precipitation at Ukiah, the only place in the area at which official Weather Bureau records are kept, is 37.3 inches. Of this amount 2.2 inches falls in the five months of the dry season.

The mean annual temperature is 57.6° F., which is practically the same as that at Santa Rosa, 55 miles to the south. It averages during the rainy season about 49°, or nearly 3° colder than at Santa Rosa. From May to October, inclusive, it averages about 66°, or nearly 2° warmer than at Santa Rosa. This apparently is due to the fact that this valley is not so open toward the sea as Santa Rosa Valley.

The average date of the first killing frost in the fall is November 1, and of the last in the spring April 14. The earliest recorded date of killing frost in the fall is October 16, and the latest date in the spring May 2. There is a normal growing season of 201 days.

There are very few days when the temperature goes above 100°, and the hot spells are of short duration. Snow very seldom falls, and lasts but a few hours.

The great variation in the width of the valley, its elevation, and relation to gaps in the hills through which the winds come, makes variations in precipitation, temperature, and winds in different parts of the area seem very probable, but actual data on this subject are scarce. A record of the rainfall at the power plant at the head of Potter Valley for three seasons, compared with the rainfall at Ukiah for the corresponding seasons, shows 10.7 inches less rainfall in Potter Valley. It seems probable that certain parts of the area have a greater rainfall than Ukiah, so that the extreme variations between different parts of the area is probably much greater than 10 inches. The variations in temperature, frosts, and winds also probably is considerable. This matter of local variation in climate must be taken into consideration in fruit growing in different parts of the area, but definite information on this point can not be given owing to the lack of data.

On the whole the climate is well suited to the production of general farm crops, alfalfa, hops, grapes, and most tree and bush fruits. It is not well suited to citrus fruits; there are some areas in the hills, from 500 to 1,000 feet above the valley floors, where oranges can be grown, but the area of suitable soil in these localities is very small.

Relatively few fogs occur, and these generally disappear early in the day. High winds are very rare. The coast breeze during the summer season reaches the valleys through several gaps, notably in Redwood Valley through Forsythe Creek gap.

The accompanying table, giving the normal monthly, seasonal, and annual temperature and precipitation, is compiled from the records of the Weather Bureau station at Ukiah:

Normal monthly, seasonal, and annual temperature and precipitation at Ukiah.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	44.7	86	20	6.65	2.41	5.81
January	45.1	77	12	8.35	1.23	30.75
February	47.7	82	18	6.17	7.08	12.53
Winter	45.8	86	12	21.17	10.72	49.09
March	50.2	85	24	5.55	0.68	4.56
April	55.0	92	27	2.45	0.80	0.00
May	60.4	102	30	1.26	1.63	0.00
Spring	55.2	102	24	9.26	3.11	4.56
June	67.7	107	36	0.34	0.65	0.10
July	73.4	112	39	0.02	0.00	0.04
August	71.8	114	40	0.01	Trace.	0.00
Summer	71.0	114	36	0.37	0.65	0.14
September	65.7	108	32	0.57	0.82	0.48
October	58.4	98	26	1.78	1.24	2.36
November	51.2	80	22	4.15	2.02	5.14
Fall	58.4	108	22	6.50	4.08	7.98
Year	57.6	114	12	37.30	18.55	61.77

AGRICULTURE.

Cultivation of the soil began with the first settlement of the area, between 1850 and 1860, and it is probable that the better alluvial soils were cleared during or soon after this period. Stock raising was the principal industry from the first, and the hay and most of the grain produced on the cultivated area was used for feed for the stock. It was so far to market that little besides stock could be taken out. Family orchards were set out and as a rule did very well. Wheat was milled for home consumption. In 1889 the Northwestern Pacific Railroad was completed to Ukiah, and this gave access to markets, but the farmers have been very slow to change their established system of agriculture, especially in the northern

part of the area. Soon after the advent of the railroad a few commercial orchards of pears and prunes were set out. These have been profitable. There is very much less fruit grown in this area than in the part of the Russian River Valley to the south within the adjoining county of Sonoma. This is due not to differences in soil or climate, but to the later development of transportation facilities and to the conservative character of the people. Fruit growing seems destined to be an important industry in the area, notwithstanding the fact that its extension northward has been slow.

The growing of hops began in the seventies and was a well-established industry by 1877. The soils of the alluvial stream bottoms were found particularly adapted to hops, but the industry developed irregularly, owing to the fluctuations in the market value of the crop. At present it is one of the largest industries of the area. Tobacco was grown in a small way about 1864, and it is claimed that the crop did well. At the present time, however, it is not grown.

Grapes for making wine and for table use have been grown in the area probably since the earliest settlements. Some vineyards contain large vines 30 to 40 years old. The early development of this industry was slow, but about 1900 grape growing received an impetus and has expanded steadily since that time. It is claimed that the phylloxera prevalent in the districts south of the survey has not yet passed the barrier of uncultivated hill land to the south, and that the vineyards of this area are free from that disease. The vineyards, where given proper care, have done well. They have been put out mainly on the bench and rolling lands, as the bottom lands were used for hops, alfalfa, and grain. They were introduced not to replace other crops, but to supplement them by being planted on soils not so well suited to these other crops.

It is impossible to give statistics in regard to live stock or crops in the area for the reason that the area is only a part of the county and all figures available are for the county as a whole. The information given in the following pages in regard to agriculture in the area at the present time is mainly the result of observations in the field, supplemented wherever possible by published statistics.

The principal kinds of live stock, named in order of their importance, are cattle, sheep, hogs, and horses. The rolling hills indicated on the accompanying soil map as Rough mountainous land are used for ranges for cattle and sheep (see Pl. II, fig. 2). Feed grown on the arable land, including hay, grain-hay, and alfalfa, is used by some ranchers to carry the stock through the periods of scanty pasturage and to fatten them; others depend on the range entirely. Most of the foothill soils seem best suited to pasture. The proportion of arable land devoted to the production of winter feed for stock is growing steadily less, as it is found much more profitable to grow

hops, grapes, and fruit than it is to grow feed, except in the case of alfalfa. Few horses are raised, except for farm use. Hogs are raised in considerable numbers. They are raised on the range, but are fed grain in addition. There is a large poultry farm in Hopland; the remainder of the poultry in the area is in small farm flocks.

Considerable grain is grown, especially in the northern part of the area and in Potter Valley. Wheat is the principal grain crop, closely followed by oats, with barley and corn having a smaller acreage. However, not enough grain is grown for home consumption, and flour and feed are shipped in. A larger acreage of grain-hay is grown, and all of this is used for stock feed. The grain, especially corn, does best on the alluvial soils consisting of the river flood plains and recent alluvial-fan soils. This is due not only to their high productiveness, but also to the fact that the supply of moisture can be conserved by proper cultivation during the dry season better than on the bench soils. Grain is grown on the Pleasanton and Pinole soils, but the yields are often very light and on the average the practice is not found profitable.

Alfalfa is a new crop in the area, but is gaining in favor very rapidly. It does well on soils of the Yolo series, where it can be grown profitably without irrigation. In Potter Valley the crop is grown on the Yolo soils occurring upon the alluvial fans. The upland soils, however, such as those of the Pinole series, are not so well suited to alfalfa, though if abundant water could be supplied for irrigation it seems probable that the crop would do fairly well on the bench soils. Irrigation is being tried on the alluvial soils. It seems profitable and probably will be extended, the yields being increased by this means.

The Russian River Valley is one of the main hop-growing centers of California, Mendocino and Sonoma Counties together reporting more than one-half the hops produced in the State. This is an intensive crop, requiring a large expenditure per acre in the way of equipment and labor, but giving under favorable conditions very large returns. Hops are grown from root cuttings. These are planted in hills about eight feet apart each way. After the vines begin to run they are supplied with supports. Two systems are followed in this area. In one system a permanent network of heavy wires is stretched over the field, about 16 feet above the ground. Strings reach from the wires to the ground and 6 vines from each hill are trained up these strings. This system costs about $50 an acre to install. The other system is cheaper, but it is claimed that not as good a quality of hops is raised. Poles about 7 feet long are set in each hill, and strings are stretched along the tops from pole to pole, forming a network over which the vines spread in their growth (Pl. III, fig. 1). The owner usually cultivates the fields, but the work of cultivation in the hill, pruning, suckering, trimming,

VIEW OF POTTER VALLEY, LOOKING SOUTH.

Soils of the valley floor consist mainly of recent alluvial-fan material of the Yolo and Tehama series of soils.

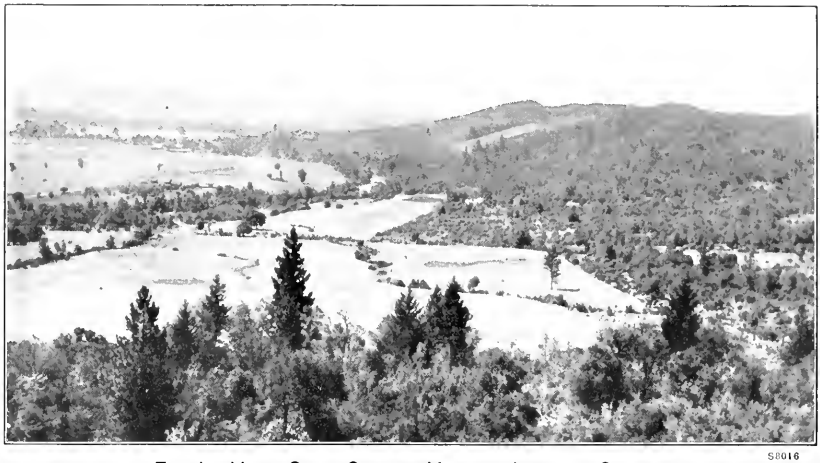

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FIG. 1.—VIEW OVER COYOTE VALLEY, LOOKING SOUTH,

Ridge of old valley-filling material defining the valley on the right. Cleared areas on this ridge in distance planted to vineyards.

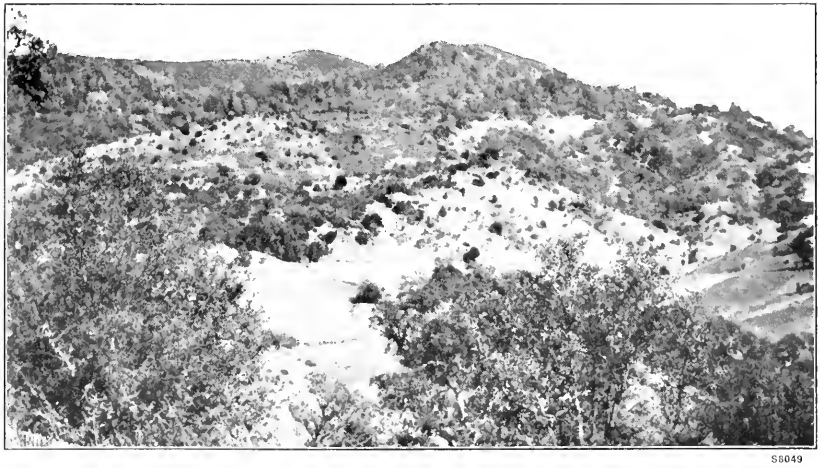

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FIG. 2.—ROUGH MOUNTAINOUS LAND, SHOWING CHARACTERISTIC TOPOGRAPHY AND FOREST COVER.

stringing, and training is given out by contract. This costs about $19 an acre if the overhead trellis is used, and $25 an acre where the small poles are used. This work is done mainly by Indian or Japanese labor. Picking is paid for by the hundred pounds. After picking the hops are taken to large drying kilns, found on every hop ranch of any size, where they are sulphured and dried by artificial heat, cooled, baled, and stored. It is reported that it costs about 9 cents a pound to grow hops. The business is highly speculative because of the great fluctuation in price. Hops give a light crop the first year, come into full bearing the second year, and remain productive for many years. Hops in this area are grown almost exclusively on the stream-bottom phases of the Yolo silt loam and the Yolo fine sandy loam. In Potter Valley a few hopyards are found also on the alluvial-fan soils of the Yolo series.

The pear industry is not extensively developed in the area, but there are a number of commercial orchards of fair size and new ones are being set out. The Bartlett is the only variety grown. Pears from this area bring top prices, as the quality is excellent. The orchards are well cared for and no blight was seen at the time of the survey, although it has been troublesome in the past. The fresh fruit is shipped to eastern markets or sold locally to the canneries. The inferior fruit is dried. What is said to be one of the most profitable pear orchards in California is located on the Yolo fine sandy loam, stream-bottom phase, near Old Hopland. Other orchards are found on the stream-bottom phases of the Yolo silt loam and the silty clay loam. Orchards are being set out on the Yolo soils of the alluvial fans and on the soils of the Pinole series. It seems probable that the Yolo silt loam and the Yolo silty clay loam of the alluvial fans will be found good soils for this crop. Its success on the bench soils is not so certain.

Prunes are grown commercially in the area and rank with pears in importance. The French Petite prune is grown almost exclusively. The orchards are found mainly on the Yolo alluvial-fan soils, with some on the stream-bottom phase of the Yolo silt loam, and new orchards are being set out on practically all the soils in the area. The bearing orchards have been profitable, but the trees do not seem to have quite the vigor and growth of trees in other prune sections of the State.

There are no bearing commercial orchards of peaches and apples in the area, but there are a large number of home orchards that in the main have done well. A few commercial orchards are being set out on the Pinole and other bench soils, and it seems probable that these soils are well suited to the production of both fruits.

Grapes are more important than any other fruit in the area. They are grown almost exclusively for wine. The vineyards are found

mainly on the higher, drier, and lighter textured soils and are located largely on soils not so well suited to other crops. The Pleasanton and Pinole soils are particularly suited to grapes (Pl. III, fig. 2), but they do well on practically all the soils of the area. The richer alluvial soils, however, may give greater returns in other fruits. The residual Mariposa loam does not seem so well suited to the grape. It is reported that the grapes grown on the upland soils of the valleys, those of the Pleasanton and Pinole series, are of better quality and have a higher content of sugar than the grapes grown on the more recent alluvial soils and bring a better price at the wineries. A start has been made toward putting the eroded phases of the Pinole loam and gravelly loam into grapes, and the prospects are very encouraging so far as the growth of the vines is concerned. There is some apprehension with respect to markets. For a number of years prices have been satisfactory and profits correspondingly high, but growers fear that adverse legislation may cripple or destroy the market for wine. Table grapes are grown in a small way, and it is claimed that many varieties do very well. These grapes are sold at local markets, but it is evident that these markets could be very easily oversupplied. No raisin grapes are grown, as the climate is not suitable for curing the product.

Casaba melons are grown for seed in the Potter Valley on the heavier members of the Yolo series of soils. The melons do very well on these soils, and the industry has assumed considerable local importance.

In the northern part of the area, especially in Redwood Valley, considerable land remains to be cleared. The clearing as a rule is done at odd times by the owners and it is difficult to give the cost per acre. There are few very large stumps to be taken out, the oak stumps being the most difficult to remove. The cost probably is between $25 and $50 an acre, depending on the nature of the forest growth. The usual custom is to continue the clearing over a number of years, which allows many of the stumps to rot out.

No data concerning the size of farms or the density of rural population are available. The impression gained from observations in the field, however, is that the population in the valleys proper is not so dense as in other more highly developed valleys to the south. The population in the hill country on the borders of the area is very sparse. The farms have never been large compared with the bonanza farms of the San Joaquin and Sacramento Valleys, and extensive types of agriculture have never developed. The farms are of medium size. In a few cases they are being subdivided.

The annual rainfall of this area, averaging between 35 and 40 inches, is considered sufficient for all agricultural purposes. This

rainfall occurs in the winter, but by careful cultivation moisture can be conserved and made to last throughout the summer. The farmers have not been forced to irrigate, as the rainfall is sufficient to give at least fair returns with ordinary farm crops. But as the types of farming have become more intensive of late years the need of irrigation has been felt. No general irrigation system has been attempted, but a number of farmers have established individual systems. There has been a small amount of gravity irrigation from springs on some of the hill farms, but the water so far utilized has been obtained mainly by pumping from the Russian River or from the underlying gravels. The Russian River in the summer often has no surface flow, but there is always a strong flow through the gravels below the bed. This has been utilized by a few farmers along the banks of the river. The water is pumped by electric or gasoline power to a height of 15 to 25 feet, and is distributed over the field by gravity. Such irrigation so far has been used only for alfalfa and garden crops. Many of the side streams that enter the valley are fed by springs and have a perennial flow through their courses in the hills. But as soon as they reach the valley floor the waters sink into the gravel and there is no surface flow except during the rainy season. Unquestionably permanent sources of water supply could be obtained near these streams if the gravel beds could be reached, but the extent of the gravel is not certain. Some wells on the uplands, away from the streams, might prove permanent. Others would certainly be only temporary. The chances of getting a certain water supply seem better as the center of the valley or the beds of the side streams are approached.

The drainage of McDowell Valley passes out through a gorge cut in bedrock. This stream goes dry in the summer, and unless there is some subterranean outlet to the drainage of the valley, which seems improbable, this indicates that there is no excess supply of water in the gravels underlying McDowell Valley and no large water supply for irrigation purposes.

Potter Valley seems to have a large supply of subterranean water, which might be pumped for irrigation. There is always a stream of water flowing out of the valley through the rock-bottomed gorge of the East Fork. The amount of outflow has increased since the headwaters of the Eel River have been diverted and brought to Potter Valley for power development. It has been proposed to use the water from this power plant for irrigation, as it could be taken by gravity to all parts of the valley, but so far only a very little is used. The farmers state that the supply is intermittent and that water is likely to be lacking when most needed. The company managing this plant has undeveloped reservoir sites which, when devel-

oped, will, it is claimed, enable them to run constantly, and in this case the water from their plant will be a valuable asset to the valley for irrigation.

The value of land in the area has increased greatly within the last few years. The best alluvial lands are selling at prices ranging from $200 an acre for unimproved land to $500 an acre for land in bearing vineyards, orchards or hop yards. The bench lands sell for $75 to $200 an acre, according to improvements. The hill lands suitable only for pasture are valued at $5 to $20 an acre. Some of the hill land, covered only with chaparral, is practically worthless.

Very little hardpan is encountered in the area, and it has no influence on the land values. Some hardpan outcrops on the hillsides of the very oldest valley filling. Where observed this is about a foot thick, of medium hardness, brown in color, and contains waterworn cobbles.

A large part of the labor on the small ranches is performed by the owners. The Indians in the area are employed as laborers in the hop fields. They are also employed to clear land and cut wood in the winter and in a small way to do general farm work. Numbers of Japanese are employed in the hop fields and in the vineyards and orchards. There is a fair supply of white labor at all times, and during the busy season of hop, fruit, and grape picking this is augmented by an abundance of transient labor. Wages are comparable with those paid in adjoining parts of the State.

SOILS.

The valleys in the Ukiah area have had a complicated geomorphic history that has not yet been entirely worked out. Holway has studied some of the problems, and the following discussion is based on his work,[1] supplemented by observations of the field party.

It seems certain that all the territory lying west of the eastern boundary of Mendocino County and embracing the area surveyed was at one time reduced to a peneplain surface and drained directly westward into the Pacific Ocean. In the latter part of the peneplain period, probably near the beginning of Quaternary time, there were local foldings and an uplift of the region as a whole. The main foldings have been accompanied and followed at different times by minor foldings or faults. A great many of these have occurred. A long, straight valley was formed parallel to the general direction of the Coast Range in this locality. Apparently the northern part of this valley was the result of a syncline and the lower part, in what is now the gorge of the Russian River in the southern part of the

[1] Holway, "The Russian River, a Characteristic Stream of the California Coast Ranges," Univ. Cal. Pub. in Geog., vol. 1, No. 1.

area, may be considered a "fault-line valley," that is, a valley produced by erosion but following the line of a fault because along such line erosion was easiest. The Russian River in its headward erosion from the south has been guided by these faults and foldings and has entered and drained this large valley. Therefore the depression, including the main agricultural valleys, is considered a structural valley, and the gorge in the southern part of the area an erosional valley.

The main structural valley just mentioned, produced by the syncline which includes the arable valleys of Redwood, Calpella, Coyote, and Ukiah, was a large, elliptical depression extending from the head of Redwood Valley to the southern end of Ukiah Valley, a distance of about 18 miles, and averaging through most of its length from 3½ to 4½ miles wide. This originally large valley has been modified by later developments in the rising and sinking of small parts and by being filled partly or entirely by deposits of alluvial fans or deltas from the side streams, notably Forsythe Creek, and the east fork of Russian River. Immense quantities of material were deposited in the valley. The actual depth of this old valley filling is not known. One well in the southeastern part of Potter Valley was bored 400 feet through blue clays which are probably old valley-filling material. It probably is 1,000 feet thick in places. It has been eroded considerably since the first deposition and either carried away or reworked, but large remnants of the first filling still remain. These remnants are high and are badly eroded, and for the most part are nonarable, thus decreasing the size of the arable part of the valley and dividing it up into smaller valleys. From an agricultural standpoint this oldest eroded valley filling differs little from the adjoining mountain slopes. The later reworked portions of this old valley filling takes the form of river terraces and is arable. South of this main valley, which extends to the vicinity of Henry station, are smaller ones, partly structural and partly erosional in origin and having a more complicated geomorphic history than the large valley just described. Potter Valley evidently lies in another syncline which has had several lesser tiltings and which has been drained by the cutting down of the gorge across the ridge to the southwest.

The large main valley received all the streams to the east and also the headwaters of the streams to the west for a short distance. This explains the peculiar direction of flow of such streams as Morrison and McDowell Creeks. They evidently have not been developed as tributaries of the present Russian River, else they would have a southwest trend. As it is, they have a northwest trend and are in line with streams on the west side of the Mendocino Ridge that flow into the ocean. They apparently are captured headwaters of these streams.

It seems probable that early in their history these valleys were lakes, for in the substratum of the old soils there are beds of silts and clays that must have been laid down in very quiet water.

At the present time all the valleys are drained. This apparently has resulted from the combined action of the cutting down of the gorge at the south end of the valleys giving an outlet to the waters, from the filling of the valleys above referred to, and probably from some crustal movements.

The rocks forming the hills surrounding the Ukiah area apparently belong largely to the Franciscan series, which are described as probably of Jurassic age[1] and consist of sandstones, shales, and conglomerates which have undergone metamorphism. Some of these rocks have been little changed and others have been greatly changed. Some are very soft and weather and erode rapidly, while others are harder and weather much slower, giving a more rugged outline to the hills formed by them. Among the harder rocks are the radiolarian cherts. Included with these sedimentary rocks are a number of igneous intrusives, some of which also have suffered great metamorphism. The igneous rocks are, first, basalt or diabase, and, second, periodites which have in general become thoroughly serpentinized. The beds and strata of these various rocks have been very much tilted, broken, and warped. In practically no case are the sedimentary rocks horizontal, as they undoubtedly were when they were laid down, but they are found now at all angles and usually are more nearly vertical than horizontal in position. Furthermore, there is very little continuity in the rocks. The fracturing and tilting has taken place in great detail. As a result of this the residual soils derived from these rocks have very frequent changes and are extremely difficult to map. These hills evidently have occupied their present relative position for a long time, for they are deeply weathered; erosion has developed a drainage system that has reached every part of the area, and the hills are mainly rounded in outline rather than rugged. No limestone rock was observed in the area, and probably little is present. A few of the springs, however, carry a high percentage of lime probably extracted from the minerals of the rocks through which their waters circulate. According to analyses (made by the experiment station of the University of California) of samples collected during the progress of this survey, the soils of the area carry a fair percentage of lime, from 0.50 per cent to 1.50 per cent, but this apparently is largely in the silicate forms, with only small amounts in the carbonate forms. A few of the soils show field indications of being mildly acid, others apparently are neutral, and the soil of the Dublin series gives indications of having a high lime content.

[1] San Francisco Folio, U. S. Geol. Survey, 1914, by A. C. Lawson.

The soils of the Ukiah area fall into three general groups: (1) residual soils; (2) soils derived from old valley-filling material; and (3) soils derived from recent alluvial deposits. The residual soils result from the disintegration or weathering of the rocks in place. In the aggregate these form a very small proportion of the valleys proper, but they occur extensively in the hills surrounding the valleys. Only small areas of the residual soils are arable. These arable portions occupy low hills and foot slopes at the edges of valleys, very small valleys back in the hills, and gentle slopes well up toward the top of the hills. Perhaps 2 per cent of the hill country is arable. The arable residual soils are classed with the Aiken series, including red soils; the Mariposa series, with grayish-yellow soils; the Olympic series, with brown soils; and the Climax series, comprising black soils. The rougher, nonarable portions of the residual soils, in which differentiation of soil series and types is not warranted, are mapped as Rough mountainous land, which includes the greater part of the hills and mountains.

The second group of soils results from the weathering of old valley-filling material. This material has been brought into the valley during former periods by streams and deposited as alluvial fans, deltas, and lake deposits. The deposits have been reworked in part a number of times by streams and have been subjected to weathering in place, usually with the development of rather heavy and compact subsoils. These deposits are not now being added to by the agencies that originally made them, but, on the other hand, are being degraded by erosion. The material forming these soils is derived from all classes of rocks found in the hills. The soils derived from the old valley deposits are classed with the Corning series, comprising the red soils, the Pleasanton series, which has dark grayish brown soils, and the Pinole series, with light brownish yellow or grayish-yellow soils.

The third general division includes the soils formed from recent alluvial deposits. They differ from the old valley-filling deposits in that they are yet in process of formation, have not been "aged" or weathered in place, and normally have rather porous, friable subsoils. They are derived from all classes of rock material eroded from the foothills and from the older valley-filling deposits. The soils in this division are classed with the Honcut series, including red to reddish-brown soils; the Yolo series, with brown soils; the Tehama series, with brownish-yellow or grayish-yellow soils; and the Dublin series, which has black soils. The Yolo series have stream-bottom phases, which are river flood plain soils. They differ from the alluvial-fan soils in being the flood plains of perennial streams, while the fans are the deposits of intermittent streams. This third division includes

Riverwash, a type of miscellaneous material of nonagricultural character.

The following table gives the name and actual and relative extent of each soil type mapped in the area:

Areas of different soils.

Soils.	Acres.	Per cent.	Soils.	Acres.	Per cent.
Rough mountainous land	131,648	67.7	Riverwash	1,920	1.0
Pinole gravelly loam	10,816	11.4	Tehama loam	1,344	.7
Eroded phase	11,200		Pinole loam	960	.7
Yolo silt loam	2,816	4.0	Eroded phase	320	
Stream-bottom phase	5,056		Pinole sandy loam	896	.5
Yolo gravelly loam	4,352	3.1	Corning loam	896	.5
Stream-bottom phase	1,664		Aiken loam	768	.5
Mariposa loam	5,760	3.0	Heavy phase	128	
Yolo loam	2,816	1.5	Yolo silty clay loam	256	.2
Stream-bottom phase	128		Stream-bottom phase	128	
Yolo fine sandy loam, stream-bottom phase	2,752	1.4	Dublin clay	320	.2
Corning gravelly loam	2,368	1.3	Honcut loam, red phase	192	.1
Eroded phase	128		Tehama silt loam, poorly drained phase	192	.1
Pleasanton gravelly loam	2,176	1.1			
Olympic loam	1,920	1.0	Total	193,920	

RESIDUAL SOILS.

Mariposa Series.

The Mariposa soil is pale yellow or yellow to grayish yellow or yellowish brown in color. The subsoil, where present, is heavier than the surface soil and as recognized in this survey is grayish yellow or pale yellow to bluish gray in color. The bluish-gray color prevails wherever the subsoil extends much below the 6-foot section. The subsoil is underlain by bedrock, and this usually occurs within 6 feet of the surface.

The topography is rolling or hilly to mountainous, and drainage is excessive, but the hills are round and smooth, broken only by occasional steep-sided ravines or marred in places by the marks of small landslides. Rock outcrops occur in places.

The Mariposa series is residual in origin. The principal basis of differentiation from other residual soils in the area is its color. It is formed mainly by the weathering of the softer, unmetamorphosed or slightly altered sandstones and shales which are probably correlated with the geological formation known as the Franciscan series of rocks and which are intimately interbedded, upturned, broken, and generally mixed. Only one member of this series, the Mariposa loam, occurs in the area. As mapped it may include minor undifferentiated bodies of soils of the Altamont series, which includes brown soils of similar origin but is not recognized in this area, or of soils derived from old valley-filling deposits.

MARIPOSA LOAM.

The soil of the Mariposa loam consists typically of a pale-yellow or grayish-yellow loam from 1 to 3 feet deep, though in this survey the type includes yellowish-brown variations. The material is compact in structure, low in organic-matter content, and difficult to cultivate. The subsoil, where present, is a clay loam or clay. It is compact and impervious and is pale yellow or brownish yellow, with bluish-gray variations. The bluish-gray material is found at lower depths, next to the parent bedrock. The type is underlain by the shales and sandstones from which it is derived, and these may occur directly under the surface soil at a depth of 1 or 2 feet, or lie 10 to 20 feet below under the heavier subsoil. There are therefore two variations of this type, one with a shallow soil and the other with a deep subsoil. In the shallow areas there is little or no subsoil, and the surface soil rests directly on the bedrock at a depth of 2 or 3 feet, with an occasional outcropping of the bedrock. In the deeper areas the heavy subsoil is always present, and bedrock may not occur within the 6-foot section. These variations grade into each other, and they are not separated on the map on account of the practical difficulty of examining the soil section.

The Mariposa loam is distributed throughout the area, occurring on the border of the valleys and occupying the lower foothills or ridges. It is bounded on the side away from the valleys by Rough mountainous land, which rises to higher elevations. In many places the boundary between this type and the Rough mountainous land is rather arbitrary. The topography is rolling, but the hills are rounded and smooth. They rise from 100 to 200 and even 400 feet above the general level of the adjoining valley floor. These hills are parklike in appearance, being covered with native grasses, with a sparse growth of blue oak, valley oak, and buckeye. Manzanita grows on the broken slopes, and Douglas fir is found in places. In Potter Valley yellow pine and digger pine are found on the soils of this series, as well as on adjoining soils to a small extent. In many places the surface is marked by peculiar irregularities caused by landslides. These may cover an area from a few square rods to an acre in size. They occur where the soil is deeper and apparently are caused by a lessening of the cohesion through the saturation of the soil, which allows the soil to slide on the compact underlying clay. Erosion is active, but the surface, except for occasional ravines, is not broken or rough. Drainage is good to excessive.

The type is used for pasture, and on account of the thin forest growth and the good growth of grasses it is highly prized for this purpose. Very little of it has been cultivated, and it seemingly has

little value for crop production. Grain is very poor, and vineyards make a slow growth and are unproductive.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Mariposa loam:

Mechanical analyses of Mariposa loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573022	Soil	1.0	3.0	2.4	15.6	23.6	34.7	19.6
573023	Subsoil	1.1	3.0	1.9	11.9	17.3	34.4	30.6

AIKEN SERIES.

The soils of the Aiken series are red.[1] The subsoil where present has the same color, or is somewhat lighter. The rock from which the soil is derived is usually between 2 and 4 feet below the surface, but in a few places it may lie below the 6-foot section. Rock outcrops are numerous. The topography is sloping to hilly, and surface drainage usually is excessive. The slopes in many places are quite steep.

The soils of the Aiken series are residual in origin and are typically derived from igneous and metamorphosed igneous rocks of basic or quartz-free character. As occurring in this survey they are derived, apparently, from the Franciscan series of rocks, for the most part hard and highly metamorphosed, partly sedimentary and partly igneous in origin.

These soils are differentiated from the Mariposa and Climax series on the basis of color, but it is found also that the Aiken soils are derived prevailingly from the metamorphosed and igneous rocks rather than from the sedimentary or feebly metamorphosed sedimentary rocks giving rise to the Mariposa and Climax soils.

As mapped, however, the soils of the Aiken series probably include locally some small undifferentiated areas of soils which are derived from the sedimentary rocks and which if more extensive would be recognized under distinct series heads. The native vegetation of the series in this area consists of oak, fir, redwood, madroña, manzanita, chamisal, poison oak, and a varied chaparral. The dense covering of trees and bushes is in sharp contrast to the growth on the Mariposa soil, which is open and parklike.

AIKEN STONY LOAM.

The Aiken stony loam is indicated on the soil map by stone symbols in color of the Aiken loam. The soil is a red or brownish-red to

[1] Yellowish-red or orange variations occur in the present area.

rusty-red loam, containing a high percentage of angular fragments of rock. As a rule these fragments gradually increase in quantity with depth, bedrock being encountered at 2 to 4 or, in extreme cases, 6 feet below the surface. The soil is friable, but is rather difficult to cultivate, owing to its stony nature and the prevailing steeply sloping surface.

Only two small areas of this type are shown on the map. Both occur in the southern part of the area, one near Cummiskey and the other on the Mendocino-Sonoma County line. Other bodies too small to map occur within the Rough mountainous land areas. The topography is steep to hilly, erosion is quite active, and drainage is excessive. The cleared areas of this soil are devoted to vineyards and young orchards, to which the soil is well suited.

AIKEN LOAM.

The soil of the Aiken loam is typically a light-red to brownish-red or yellowish-red loam usually from 1 to 2 feet deep, but in places having a depth of 4 feet. The yellowish or orange tint is often pronounced, and is much more strongly developed than in this type as mapped elsewhere. The soil is of friable structure and is easy to cultivate. It contains varying quantities of angular rock fragments, but not enough seriously to interfere with cultivation. The subsoil where present extends from the surface soil to the bedrock, and usually is light red or even yellow in color. The bedrock is encountered in most places at depths of less than 4 feet, and rock masses in some places outcrop.

This is an unimportant type. It occurs in small areas at the base of the hills, bordering the floors of the valleys, and also in comparatively level areas back in the hills, where besides the areas shown there are many small areas too small to map. This type often includes some undifferentiated alluvial or colluvial foot-slope material on the lower edge, and on the upper margin merges with the Rough mountainous land lying above it. It is sloping to steep in topography, and occupies some of the more nearly level parts of the hill region. It is all arable, but some of it is so steep that it can be tilled only with difficulty. Erosion is active and drainage good.

Cleared areas of this soil are used for the production of fruit and garden crops. It is productive, but its value is limited by the fact that it occurs in small areas, is often inaccessible, and lies on steep slopes. As the development of the region progresses, however, more of the small areas of this soil occurring in the hills probably will be brought under cultivation.

Aiken loam, heavy phase.—The soil of the Aiken loam, heavy phase, varies considerably in texture and color. Prevailingly it is a red or dark-red heavy loam or clay loam containing some small

angular fragments of the parent rock but not enough seriously to affect cultivation. In this survey much of it is somewhat deeper red than in previous surveys. The subsoil is similar to the surface soil in color and texture, but contains more rock fragments. Bedrock is found at varying depths, but lies usually between 3 and 5 feet below the surface.

Only one area of this phase is mapped, a narrow strip on the eastern edge of the main valley near Largo, but many other bodies too small to map separately lie within the areas of Rough mountainous land.

The surface is sloping to rather steep, erosion is active and drainage is fairly good. Some undifferentiated bodies of other types, notably the Climax clay adobe, too small to be shown on the map, are included with this heavy phase of the Aiken loam.

The phase is used mainly in growing grain, of which the yields are good. Some orchards have been set out on it recently.

Results of mechanical analyses of samples of soil of the typical Aiken loam and the heavy phase follow:

Mechanical analyses of Aiken loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Typical: 573011	Soil	6.4	7.6	2.4	9.9	18.8	39.3	15.9
Heavy phase: 573051	Soil	9.8	10.6	4.2	9.6	8.4	32.4	25.1

OLYMPIC SERIES.

The soils of the Olympic series are brown to rather dark brown; the subsoil, where present, is gray or grayish brown to brown in color and of similar or somewhat heavier texture and more compact structure than the surface material. Bedrock usually is encountered within 6 feet of the surface, and there are frequent areas of shallow soil marked by rock outcrop. The topography is rolling to steep and hilly, and drainage thorough to excessive.

The Olympic soils are residual in origin and are derived from basic igneous and metamorphic rocks. In this area they are derived almost entirely from metamorphosed igneous rocks, among which serpentine is very conspicuous. They are differentiated from the Climax soils, with which they are closely associated in origin and occurrence, on the basis of color, the Olympic soils being brown and the Climax soils black. They are distinguished from the Mariposa soils also by color, but the rocks which produce them have a larger proportion of

the basic igneous and highly metamorphosed igneous rocks than the Mariposa soils.

In this area the surface of the Olympic soils in places is smooth, but in other places it is marked by old slips or landslides. The native vegetation is mainly grass. There is a scattering of trees, with a thicker growth in the ravines and on very steep slopes.

As mapped these soils may include small undifferentiated areas of black soils, which in this survey are recognized as the Climax series, and of brown residual soils derived from sedimentary and only feebly metamorphosed rocks.

OLYMPIC STONY LOAM.

The Olympic stony loam is shown on the soil map by stone symbols in the Olympic loam color. The soil and subsoil are similar to those of the Olympic loam, except for the large content of angular rock fragments in the soil and subsoil and on the surface. Outcrops of bedrock are also more frequent than in typical areas of the Olympic loam, and it is probable that the average depth to bedrock is not so great.

Several areas occur on the east and north sides of Potter Valley and most of the cultivated soil at Cummiskey is of this type. The topography is sloping to steep, erosion is active, and drainage is excessive. The areas in Potter Valley are in pasture, and the cleared land at Cummiskey is devoted to grain and grapes. This soil seems well adapted to grapes, but the topography renders cultivation difficult. It lies from 100 to 400 feet above the river, and the fields are bordered by ravines and precipitous slopes too steep for agricultural use.

OLYMPIC LOAM.

The soil of the Olympic loam is light brown or grayish brown to dark brown, and has a rather compact structure. It varies in depth from 1 to 3 feet, and contains some angular rock fragments. The subsoil, where present, is very similar to the surface soil both in color and in texture. The rock from which the soil is obtained is usually encountered at depths of 2 to 5 feet, and in a few places outcrops.

The Olympic loam is mapped in several areas on the east side of Potter Valley, in two areas just north of Largo, and in two small bodies in the southern part of the area surveyed. Its topography is gently sloping to steep. Erosion is active, and drainage is well established. At present, the Olympic loam is used almost exclusively for pasture, for which it seems well suited. So little of it has been cultivated that it is impossible to say definitely what its agricultural possibilities are, but the prospects are not very encouraging.

Climax Series.

The soils of the Climax series are dark gray to black, and rest on subsoils usually of brown or yellow color. Bedrock underlies all the areas covered by these soil types at shallow depths, usually within the 6-foot section. There are many areas of thin or shallow soils and rock outcrop.

The soils of this series occur in moderately hilly to mountainous districts. The soils are residual, being derived from metamorphosed rocks, probably of basic igneous origin, among which serpentine is very often present. They are closely allied to the Olympic soils in origin and mode of formation, but differ in color, the Olympic soils being brown and the Climax soils black.

In this survey the Climax clay adobe is the only member of the series mapped. The topography is moderately hilly or sloping, and the surface is smooth. The vegetation consists entirely of herbaceous plants.

Climax clay adobe.

The Climax clay adobe, owing to its small and rather indefinite extent, is indicated on the soil map by inclusion symbols in areas of the Olympic loam. The soil is a dark-gray to black clay from 18 to 24 inches deep. It has a pronounced adobe structure, becomes very sticky when wet, bakes and checks upon drying, and is extremely difficult to cultivate. The soil grades into a dark grayish brown or yellowish-brown clay, which in turn rests upon bedrock at 4 to 6 feet below the surface. This soil is apparently well supplied with organic matter and lime. Under normal conditions it is black or nearly so, but the surface when extremely dry and bleached by the sun, especially if powdered, has a light-gray color. The dark color returns, however, as soon as the soil is made wet.

Two small areas of the Climax clay adobe are mapped on the east side of Potter Valley, but many small bodies from a few square rods to a few acres in size and too small to be shown on the map are scattered over the low hills bordering the valley throughout most of its length, and are included with areas of the Olympic and other residual soils and Rough mountainous land.

The topography is nearly level to sloping, and erosion is moderate. Most of the type is in pasture. A few small bodies included in other types are under cultivation, and are fairly productive though very hard to cultivate.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Climax clay adobe.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573030	Soil	1.5	2.1	1.1	5.6	9.4	33.6	46.8
573031	Subsoil	1.3	2.6	1.2	5.6	9.4	34.0	45.8

MISCELLANEOUS.

ROUGH MOUNTAINOUS LAND.

The Rough mountainous land includes most of the hill land bordering the valley proper on both sides. (Pl. II, fig. 2.) Very little of the surface can be classed as Rough stony land or Rock outcrop, but the land is too steep to plow and is nonarable mainly for that reason. Most of the hills are covered with residual soils, mainly of the Mariposa and Aiken series, with some of the Olympic and Climax series. The soil is shallow and subject to severe erosion. Small, detached areas of arable land are scattered through the hills, on the gentler slopes or in small valleys. Some of these have been cleared and farmed. Others no doubt will later be brought under cultivation, but the total arable area is very small, probably not more than 2 per cent of the area mapped as Rough mountainous land. Some of the gentler hills, those derived from the softer sandstones and shales, are grass covered with a scattered growth of valley oak or blue oak, which gives them a parklike appearance. These hills are rounded in outline, with only occasional rock outcrops. The soils are yellow or gray in color. The hills of this character gradually give way to steeper hills of harder rocks—metamorphosed sedimentary rocks or igneous intrusions—with shallower, mainly brown or red soils, and more numerous rock outcrops. The vegetal covering includes trees and shrubs. Douglas fir and redwood grow in the ravines and on sheltered hillsides, and oaks of various species on many of the medium slopes. Many of the more exposed hilltops have no trees but are covered with chaparral.

The Rough mountainous land is valuable for pasture, the more open hills affording much the best pasturage for sheep and cattle. The timber is valuable for firewood and charcoal. All timber suitable for sawing into lumber has long ago been removed.

The small included areas of arable land are often well suited to fruit culture. Even oranges are grown on the hills 500 feet above the valley floor, though it is entirely impracticable to grow them

in the valley. They are grown only in isolated cases, however, and not commercially.

SOILS DERIVED FROM OLD VALLEY-FILLING MATERIAL.

Corning Series.

The soils of the Corning series are pale red or yellowish red. The subsoils are pale red or red, occasionally yellowish, and heavier and more compact than the surface soil.

In exposed sections stratified beds of cobbles, gravels, sands, and finer materials of compact or partially cemented structure occur at 4 to 8 feet below the surface. It is probable that this substratum is present throughout the series in this area, but this could not be determined in all cases.

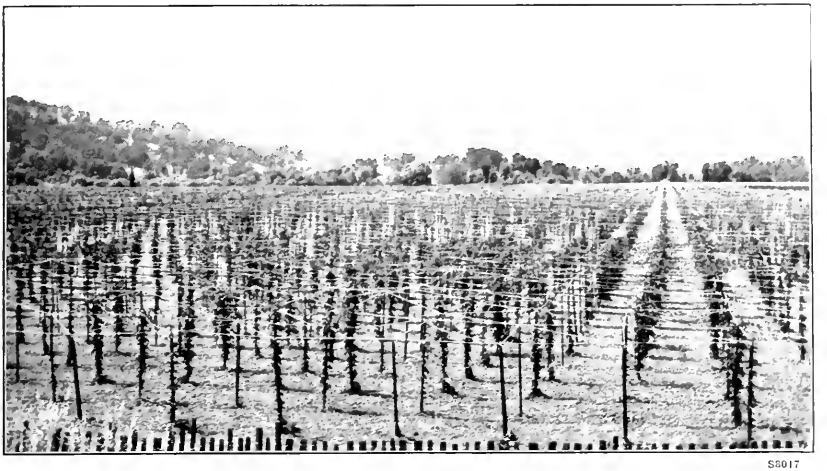
The Corning series is derived from old valley-filling material, having its source in a variety of rocks. In origin and mode of formation it is similar to those of the Pleasanton and Pinole series, and it is differentiated from them on the basis of color. In this survey much of the parent material seems to have been deposited as old alluvial fans and to some from sandstones, shales, conglomerates, and intrusives of the Franciscan series of rocks.

The soils occupy gently sloping to rolling terraces or benches. The surface is usually smooth, although in some high dissected areas the slopes may be steep. The native vegetation consists of white oak, black oak, and live oak, Douglas fir, madroña, manzanita, and various small trees and bushes, for the most part forming a dense growth. Where the clay subsoil approaches the surface, hindering drainage, the forest covering is scattered and parklike, or gives way entirely to a covering of grass. In Potter Valley the covering is parklike, and some yellow pine is found.

Corning loam.

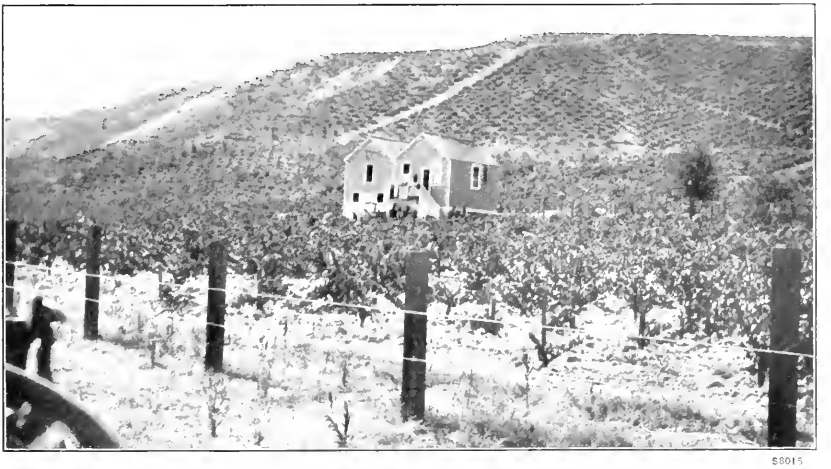
The soil of the Corning loam is predominantly a pale-red or yellowish-red loam, containing some gravel, and from 12 to 24 inches deep. The subsoil is a tenacious clay loam or clay, pale red or brownish red, or even yellow in color, and usually containing considerable gravel. It is underlain at depths of 4 to 8 feet by a substratum of clay containing cobbles and gravel, partially cemented and unfavorable to the passage of water and penetration of roots. In bleached surfaces, especially where finely pulverized, the soil has a yellow color.

Two areas of this type are mapped on the east side of Redwood Valley, several areas are found in Potter Valley, and two small areas occur near Guidiville. The topography is level to gently rolling and



S8017

FIG. 1.—HOPS ON STREAM-BOTTOM SOILS OF THE YOLO SERIES.



S8015

FIG. 2.—DRY-WINE GRAPES ON PINOLE GRAVELLY LOAM, OLD VALLEY-FILLING MATERIAL.

Slopes in background consist of the eroded phase of this type.

S8018

FIG. 1.—SECTION IN MATERIAL OF CORNING GRAVELLY CLAY LOAM, OLD VALLEY-FILLING MATERIAL.

S8014

FIG. 2.—PEACH ORCHARD ON CORNING GRAVELLY CLAY LOAM, NORTH OF COYOTE VALLEY.

FIG. 1.—SECTION IN OLD VALLEY-FILLING MATERIAL OF PINOLE GRAVELLY LOAM, NEAR UKIAH.

FIG. 2.—STREAM-BOTTOM SOILS OF THE YOLO SERIES, NEAR UKIAH.

Terraces in distance occupied by soils of old valley-filling material.

the surface smooth. Drainage is good, except in a few places where, owing to an impervious subsoil, it is deficient.

The Corning loam in the Potter Valley is mainly in pasture. That in Redwood Valley is partly uncleared; the cleared portion has been used for pasture and grain production, but some of it is now set to fruit.

Results of mechanical analyses of samples of soil and subsoil follow:

Mechanical analyses of Corning loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573032	Soil	4.6	7.1	4.6	16.2	19.2	32.8	15.5
573033	Subsoil	5.4	12.0	6.2	18.9	12.4	25.8	19.6

CORNING GRAVELLY LOAM.

The surface soil of the Corning gravelly loam is a pale-red to brownish-red loam from 18 to 36 inches deep, containing large quantities of waterworn gravel, consisting mainly of quartzite material. The subsoil is a pale-red or brownish-red to yellowish clay loam or clay, containing varying quantities of gravel, in some places sufficient to give a gravelly clay. It is underlain at varying depths, usually below 6 feet, by the typical substratum of the Corning series. When the soil is dry and powdery it is dull yellow, the typical red color being seen in freshly plowed fields.

A large area of this soil occurs on the east side of Redwood Valley, and small areas in Potter Valley, near the Yokayo Rancheria, northwest of Ukiah, northwest of Central School, and south of Old Hopland. It occupies low terraces, with smooth and sloping to gently rolling surfaces. Erosions are seen in places, but well-defined drainage channels do not as yet reach all parts of the areas. Some of this soil lacks surface drainage, and the subdrainage is generally more or less retarded by the compact substratum.

Much of the Corning gravelly loam is uncleared and is densely covered with oak, Douglas fir, madroña, and brushy undergrowth. Some of it, farmed to grain, has proved fairly productive.

On a part of it orchards are being planted.

Corning gravelly loam, eroded phase.—The Corning gravelly loam, eroded phase, which is indicated on the soil map by crosslines over Corning gravelly loam color, covers a small area in the western part of Potter Valley. It occupies a high position, and is so badly eroded that its agricultural value is materially impaired. It has the general characteristics of the typical Corning gravelly loam, but differs in its

topography. The slopes are generally steep and drainage is excessive. The area occupied by this phase is still uncleared and undeveloped.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil of the Corning gravelly loam:

Mechanical analyses of Corning gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573009	Soil	7.8	6.3	2.6	10.3	15.0	41.0	16.9
573010	Subsoil	3.0	4.0	2.0	8.2	13.4	34.1	35.3

CORNING GRAVELLY CLAY LOAM.

Owing to its small extent, the Corning gravelly clay loam is indicated on the soil map by inclusion symbols in the color of the Corning loam. The surface soil is a dark-red clay loam about 2 feet in depth, containing subangular gravel. The subsoil is a red to mottled red and yellow clay loam to clay, containing gravel, passing into the gravelly substratum below a depth of 6 feet. The red color of both the soil and subsoil is much darker than that of the other soils of this series in the area. The substratum is a mass of angular or subangular cobblestones from 1 to 4 inches in diameter. (Pl. IV, fig. 1.) The greater part of this material is quite thoroughly weathered, and is easily broken with the geologist's hammer. The surface soil has evidently been produced by the advanced disintegration and weathering of this material and contains angular fragments about the size of small gravel, which have resulted from the breaking down of the harder cobbles. The finer soil material has come from the breaking down of the fragments of softer rock.

One area of this soil occupies a remnant of a high terrace or old alluvial fan just north of Coyote Valley. This area slopes gently to the west and north and has a fairly smooth surface. Erosion is more or less active and drainage is good. Some small bodies of soils of lighter texture belonging to the same series, which are too small to be shown separately on the soil map, are included. The color of soil in these areas is lighter, in places being brownish gray.

A second very small body of soil of similar character occurs on the high terraces south of Coyote Valley.

Much of the Corning gravelly clay loam is in a high state of cultivation, being set to fruits of various kinds (Pl. IV, fig. 2) or used in the production of truck crops, all of which do well. A part of it is in grain and a part is yet uncleared. It is a good grain soil.

Mechanical analyses of samples of the soil and subsoil follow:

Mechanical analyses of Corning gravelly clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573046	Soil	3.5	6.8	3.4	12.5	12.2	34.1	27.4
573047	Subsoil	2.9	4.1	2.1	6.6	11.4	35.9	37.1

Pleasanton Series.

The soils of the Pleasanton series are typically brown, with variations of grayish brown, light brown or dark brown. The subsoils generally are heavier than the surface soils and more compact and lighter, usually a yellowish brown or grayish brown. The subsoils are underlain typically at some depth less than 6 feet by a stratum of open to rather compact, though not cemented, gravel. The series is derived from old valley-filling material and occupies the better drained areas of terraces and benches.

The Pleasanton series is distinguished from the Pinole series, to which it is closely related both in origin and in occurrence, by its darker colored surface soil.

In this survey the Pleasanton soils depart in certain characteristics from the series as developed in areas previously covered by the soil survey. The surface soils are somewhat darker, the subsoil is not heavier than the soil, and the underlying gravel stratum is poorly developed or displaced by interbedded strata of gravel, sand, silt, and clay, slightly cemented and usually of various shades of gray or brown. These beds show that they were deposited in water which at certain stages was quiet.

In this survey only one member of this series, the gravelly loam, is mapped. There are a very few small areas of loam, but they are too small to be shown separately on the map.

Pleasanton gravelly loam.

The soil of the Pleasanton gravelly loam is a grayish-brown to dark grayish brown loam, with a relatively large proportion of gravel. The subsoil encountered below a depth of 12 to 20 inches is a yellowish-gray or grayish-brown loam, several shades lighter than the surface soil. A 6-foot section of the soil usually shows several changes in color, texture, and quantity of gravel. In any section there are layers which are quite gravelly and other layers nearly free from gravel, and the gravelly layers may occur at any depth.

This is a widely distributed type, the larger and more important areas occurring north and south of Ukiah, in the valley of Forsythe Creek, near Coyote School, and along Cold Creek.

The topography is nearly level to gently sloping, and in places, where erosion has cut back into the edge of the terrace, gently rolling. The surface is in general smooth. The type originally supported a forest growth, but has been largely cleared for farming. It is used for the production of grain, to which it is only fairly well adapted, the yields decreasing after a few years cultivation. The soil seems well adapted to grapes, and large commercial plantings have been made. Other fruits probably would do well. It is said that the Pleasanton gravelly loam is better suited to fruit than the closely associated Pinole gravelly loam.

Pinole Series.

The soils of the Pinole series are typically pale yellow or brownish yellow, with light yellowish brown to light grayish brown variations. They are underlain by subsoils of similar or heavier texture but of somewhat lighter yellow or gray color. At varying depths below 6 feet occurs a stratum consisting of interbedded layers of clay, silt, and fine sand, and some of gravel. All these beds are slightly cemented, and seams in the clay and silt beds have a coating of lime. The color of this substratum varies from dull yellow to light brown, drab or gray.

The Pinole soils occupy benches, having usually a smooth, level or gently rolling surface. They are derived from old valley-filling material. They were originally densely forested.

Pinole sandy loam.

The surface soil of the Pinole sandy loam is a light brownish yellow, light-yellow or yellowish-brown sandy loam, about 1 to 2 feet deep. This is underlain by a yellow or brownish-yellow loam to compact clay loam subsoil, which extends to a depth of 6 feet or more. Where the heavier subsoil occurs near the surface it materially affects the agricultural value of the land by retarding subsurface or internal drainage and root development, but in most places it lies below a depth of 6 feet, which is deep enough to allow a proper growth of grapevines or of shallow-rooting fruit trees. This soil has a small content of organic matter.

This is a type of little importance, found in only a few areas. One high, eroded area lies in the western part of Potter Valley. Small areas lie near El Roble, northeast of Ukiah, and south of Guidiville at Carrol School. A larger area extends south and east from Guidiville.

The topography is gently sloping or rolling to rather steep, but the surface is smooth. Erosion is active and surface drainage is well established. The area in Potter Valley is in pasture, and has a thin covering of blue oak. The other areas are mainly in vineyards. Grapes, and, in family orchards, apples, peaches, and apricots, give good returns.

In a gravelly variation of this type, which is indicated on the soil map by gravel symbols, the soil is a yellowish-gray sandy loam, containing considerable fine gravel about the size of a pea. The subsoil encountered at a depth of about 3 feet is a gravelly sandy loam. Only one area of this variation is mapped. This occurs in McDowell Valley, where it occupies the main part of the floor of the valley. The surface is gently sloping.

This area is devoted to general farm crops, and is quite productive. Grapes are grown to a small extent.

PINOLE LOAM.

The Pinole loam is a brownish-yellow to yellowish-brown or light grayish brown loam about 2 feet deep, underlain by a subsoil of the same texture, but slightly lighter in color. Cobblestones and gravel are scattered through soil and subsoil, but they are not present in sufficient quantity to give a stony or gravelly type. The substratum, characteristic of the series, is encountered at depths of 6 to 10 feet.

The areas of the Pinole loam in Potter Valley and the body on the east side of Knights Valley are largely covered with grass, with a scattered growth of trees, and in this regard the type differs from the other members of the Pinole series.

This type is of small extent. One area occurs at the head of Redwood Valley, and another along Forsythe Creek. Several areas occur in the southeastern part of Potter Valley; one small area is encountered near Henry, and another in the McDowell Valley.

The type occupies low hills with smooth surfaces and has a gently rolling topography. It is well drained. The soil is either uncleared or is used for pasture, but it seems probable that with proper management it would be well suited to fruits.

Pinole loam, eroded phase.—The Pinole loam, eroded phase, is indicated on the soil map by cross-lining. It is separated from the typical soil on the basis of difference in agricultural value. In soil, subsoil, and substratum it is very similar to the typical soil, differing only in that the surface material is in many places eroded away, leaving the subsoil or substratum exposed. The surface is so steep and hilly that cultivation over much of it is very difficult or impossible.

This phase lies at a higher level than the areas of typical soil, and is derived from older alluvial-fan deposits. It is mapped in small

areas adjoining the hills in the southern end of Potter Valley and in an area of moderate extent east of El Roble. It is not farmed, but supports a good growth of timber.

PINOLE GRAVELLY LOAM.

The soil of the Pinole gravelly loam is a brownish-yellow or light yellowish brown loam about 2 feet deep, containing a large percentage of gravel. The subsoil is very similar to the surface soil in texture and gravel content, but the color is generally a little lighter, yellower, and grayer. The gravel is mainly less than an inch in diameter and consists largely of sandstone and metamorphosed sandstone and shale containing seams and lenses of quartz. The gravel is rather unevenly distributed, in places 2 or 3 times as much as in other places, but nowhere is it entirely absent. There are some large cobbles up to 6 inches in diameter, but these are relatively rare. The type is not markedly leachy. The amount of organic matter present is only moderate. The type is underlain at depths below 6 feet by the substratum typical of the Pinole series. Plate V, figure 1, shows a section in this soil near Ukiah.

Although the typical color of the Pinole gravelly loam under normal conditions is prevailingly as described, showing dull yellow rather than red in the soil and subsoil, there are places, in which the soil is wet during the rainy season, where there is a faint pink or red color in the subsoil.

Slight depressions in this type are often occupied by soil which varies from the typical in having a yellow clay loam or clay subsoil. This is like poorly drained phases of the Tehama soils, but the bodies are too small to be shown separately on the soil map. They are very inferior to the main portion of the soil. Drainage is very poor, the soil appears to be acid, puddles easily, and bakes. It is said, however, that grapes do well in these spots.

The Pinole gravelly loam is one of the important types of the survey and is widely distributed. It is found on the terraces and benches of old valley-filling material skirting the sides of the valley and occurs in disconnected areas from the northern part of Redwood Valley to the southern part of Sanel Valley. It occurs also in Potter Valley, in McDowell Valley, and in several of the small valleys of lateral streams. In places the type has a terrace topography, and in others the topography of old alluvial fans, but it has all undergone erosion, so that drainage is well established. The topography varies from nearly level to gently sloping. Much of this type is well suited to irrigation, if water can be supplied.

At present the Pinole gravelly loam is used to some extent for pasture, vineyards, and grain farming. A large part of it is uncleared.

For pasturage, hay or grain, this soil is only moderately productive. When first cleared, it gives satisfactory yields, but they soon decline. For this reason many farmers consider it a poor soil, but it is well adapted to the production of grapes, and many commercial vineyards have been set out. It is probably well suited to other fruits, such as apples, prunes, and peaches, but there are no bearing commercial orchards upon it.

Pinole gravelly loam, eroded phase.—The Pinole gravelly loam, eroded phase, occupies high-lying, eroded areas, in which there remains no level land. It forms steep hills, and has a much lower agricultural value than the typical areas, as cultivation is extremely difficult and expensive. Very little development has been attempted, except in smoother parts, where dry-wine grapes are grown locally with success (Pl. III, fig. 2).

The soil profile is practically the same as that of the typical Pinole gravelly loam, except that the surface soil is in many places eroded away, exposing the subsoil or even the substratum.

Large areas of this phase are found on the old alluvial fans of Forsythe Creek and the east fork of the Russian river. The range of hills dividing Coyote Valley and the narrow Calpella Valley is occupied by this soil. A large area lies south of Coyote Valley and extends along the east side of the main valley to Ukiah. Other large areas occur farther south for a number of miles, and a few small areas are encountered almost as far south as Cummiskey. The phase occurs also in Potter Valley.

The Pinole gravelly loam, eroded phase, is practically non-agricultural. It supports a fair growth of oak, fir, and madroña on favorable slopes, but often the covering consists only of chamisal or ceanothus.

SOILS DERIVED FROM RECENT ALLUVIAL DEPOSITS.

Yolo Series.

The Yolo soils are brown, with variations of light brown, grayish brown or dark brown, and with subsoils usually of the same texture or of somewhat lighter texture, and of the same or slightly lighter color than the surface soil.

These soils typically occupy gently sloping to nearly level recent alluvial fans with a smooth surface. The fans are steepest where they adjoin the hills, the outer edges being more nearly level. In this survey the Yolo soils have stream-bottom or river flood plain phases, which are extensive and important.

The Yolo soils are derived from recent alluvial deposits having their source mainly in sedimentary and metamorphosed sedimentary rocks. Unlike the remnants of the older alluvial fans occupied by

the older valley-filling material, the fans occupied by the Yolo soils are not undergoing erosion and removal, but are being built up by present streams, and as a result the surface has a more uniform slope. Yolo soils have the same origin as the Tehama soils from which they are differentiated on the basis of color, being darker than the Tehama. Drainage usually is well established, but certain parts of the fans and of the lower lying flood-plain areas are subject to overflow during periods of flood. In this survey the upper subsoil usually passes into a deeper subsoil of compact gravelly material at depths of 4 to 6 feet. Valley oak, with willow along the streams, seems to have been the predominating tree growth. The typical Yolo soils in Potter Valley are parklike in appearance, with a good growth of valley oak (see Pl. I). The same is true of some of the smaller fans in Ukiah Valley. In Knights Valley the valley oak makes a particularly good growth. Originally, however, there was in places considerable smaller growth, including ceanothus, poison oak, and some manzanita. The stream-bottom areas were originally forested with a dense growth of oak, willow, and wild-grape vines, with some ash and pepperwood.

YOLO FINE SANDY LOAM, STREAM-BOTTOM PHASE.

The surface soil of the stream-bottom phase of the Yolo fine sandy loam is a light grayish brown to a medium-brown fine sandy loam. It is about 2 feet deep, and grades imperceptibly into a subsoil which is very similar in color and texture to the surface material. This is a loose, friable soil, very easy to cultivate, but with only a fair supply of organic matter. It is underlain by river gravels, but almost invariably these are found below the depth of 6 feet. On the margins of some areas next to the stream this soil merges into Riverwash, and parts of the type as mapped include bars and strips of gravel or sand too small to separate. The surface of this type when quite dry and bleached by several months of sunshine often appears lighter or grayer than it does under normal conditions.

Areas of this soil are distributed throughout the survey along the Russian River and the East Fork, occupying the parts of the river flood plains nearest the streams. The surface is level or is marked by long, shallow depressions, which are abandoned channels of the stream or are caused by the recent eroding action of floods. The drainage, owing to the open, loose character of the soil, is usually good, but in depressions it may be poor at times on account of a high water table.

The soil is, for the most part, suitable for irrigation, as it occupies a low position near the river, although the surface in places is un-

favorable. This soil is one of the most valuable in the area. One of the most profitable pear orchards in the State is located near Hopland on this phase. Little of the soil, however, is devoted to fruit. Most of it is used for the production of hops and alfalfa, to which it is especially well suited. (See Pl. III, fig. 1.) A small part of the phase is used for grain growing.

As mapped in this area the phase includes small, undifferentiated bodies of the Yolo fine sand, stream-bottom phase, which are too small to be separated satisfactorily. The soil in these areas is a light grayish brown fine sand, extending to depths of 6 feet or more without any distinct subsoil. It is very light and friable and easy to cultivate. It has a low percentage of organic matter, and contains in places some small, rounded gravel. It is underlain at varying depths by river gravels. Small areas of this soil occur east and north of Hopland, near the Russian River. It is subject to periodic overflow, and the surface is marked by gentle ridges and depressions resulting from flood erosion. Subdrainage is excessive. The productiveness of this soil is much less than that of the stream-bottom phase of the fine sandy loam, on account of its leachy nature.

Results of mechanical analyses of samples of the soil and subsoil follow:

Mechanical analyses of Yolo fine sandy loam, stream-bottom phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573028.....	Soil.....	0.0	0.2	1.2	23.0	41.4	27.2	6.9
573029.....	Subsoil.....	.0	.0	.2	4.0	31.7	50.9	13.4

YOLO LOAM.

The soil of the Yolo loam is a dark-brown or dark grayish brown loam, usually containing a small proportion of gravel. It is friable, has a good supply of organic matter, and is easily cultivated. The subsoil is encountered at depths of 18 to 24 inches. As a rule it is somewhat lighter in color than the surface soil, being a brown or light grayish brown or, in the lower depths, yellowish brown. It consists of a loam, but usually contains more gravel than the surface soil, and the percentage of gravel increases and the material becomes more compact with depth.

Large areas of the Yolo loam occur in Potter Valley, and smaller areas are found near Ukiah and farther south in the survey. The areas are gently sloping to nearly flat, with a smooth surface marked

only by occasional shifting channels of intermittent streams. Drainage is usually good, though there are a few poorly drained depressions. The type is well suited to irrigation on account of its smooth surface and gentle slope, and water for irrigation could probably be obtained.

At present the Yolo loam is mainly in grain, of which satisfactory yields are obtained. Alfalfa is grown in a small way; it can be produced successfully without irrigation. The type is well suited to fruit, although very little is grown. In Potter Valley some pear trees, over 50 years old, are healthy and bear regularly. This type constitutes good general-farming land.

Yolo loam, stream-bottom phase.—The soil of the stream-bottom phase of the Yolo loam is a grayish-brown or brown loam about 2 feet deep. It contains some gravel, but is friable and is easily cultivated. It is underlain by a subsoil of the same color and texture, but usually containing more gravel.

This phase is of small extent. One area occurs south of Hopland and another north of El Roble. The surface is level or gently undulating and is subject to some erosion and overflow during flood stages of the Russian River. The subdrainage is good. The soil is not very uniform and varies considerably in agricultural value. It is mainly in grain and alfalfa.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the typical Yolo loam and of the stream-bottom phase:

Mechanical analyses of Yolo loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573020	Soil	1.0	2.0	2.0	15.6	20.7	37.9	20.7
573021	Subsoil	1.2	2.9	3.0	24.7	22.6	29.5	16.2
Stream-bottom phase:								
573037	Soil	5.2	5.4	2.6	11.4	16.4	39.7	19.6
573038	Subsoil	3.1	4.9	3.0	13.0	18.4	34.7	22.6

YOLO GRAVELLY LOAM.

The Yolo gravelly loam is indicated on the soil map by gravel symbols in the Yolo loam color. The soil is a dark grayish brown loam, containing enough gravel to affect its texture and structure and cultural requirements. The gravel consists of small, rounded pebbles of a variety of rocks. The subsoil is encountered at depths of 18 to 24 inches. It usually is somewhat lighter in color than the surface

soil, being brown or light grayish brown, often yellowish brown in the lower part. It consists of a gravelly loam, generally containing more gravel than the surface soil, and becomes very compact at lower depths. The type is easily cultivated, has a good supply of organic matter, and retains moisture well.

Large areas of the Yolo gravelly loam are found in Potter Valley and on the east side of Ukiah Valley, and smaller areas are well distributed throughout the survey. In many cases it occurs on the upper parts of the small fans, the heavier members of the same series bordering it on the lower side. The large areas of the gravelly loam on the east side of Ukiah Valley, however, extend to the flood plain of the Russian River. The topography is gently sloping, and the surface is smooth. Drainage is well developed. This type is well suited to irrigation. Most of it is in grain, and yields are fair to good, though lower than on the stream-bottom soils. Very little fruit is grown, but the type seems well suited to grapes, prunes, and other fruits. Corn is grown extensively. This is a good soil for general farming.

Yolo gravelly loam, stream-bottom phase.—The Yolo gravelly loam, stream-bottom phase, is indicated on the map by gravel symbols and cross lines in the Yolo loam color. The surface soil is a light grayish brown or light-brown to dark-brown gravelly loam, from 1 to 3 feet deep. This is underlain by a subsoil of the same color, but generally containing more gravel. This phase is quite variable and includes small areas with little gravel, small areas of clay loam, some fine sandy loam, and in places small bodies of Riverwash. These variations are too inextensive to be indicated on the soil map.

This phase, which has a small total area, is found in small bodies distributed throughout the area. It occurs on the flood plains of the small tributaries of the Russian River and in the main valley where large tributaries of this river enter. The largest area occurs just south of Hopland. The surface is level or is marked by shallow abandoned stream channels. The streams which have formed these bodies are likely at any time to encroach on them, as their channels are continually shifting. The areas are subject to periodic overflow; otherwise the drainage is fairly good.

Grain, alfalfa, and grapes are grown on this phase. It also affords some pasturage. The different areas vary widely in agricultural value, owing to variations in texture, depth to gravel beds, and conditions of overflow. The better areas are practically as good as the stream-bottom phase of the fine sandy loam of the series.

Results of mechanical analyses of samples of the soil and subsoil of the typical Yolo gravelly loam follow:

Mechanical analyses of Yolo gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573012	Soil	1.6	1.6	1.2	10.2	18.1	47.6	19.2
573013	Subsoil	2.5	4.2	3.0	14.6	18.4	37.2	19.9

YOLO SILT LOAM.

The soil of the Yolo silt loam is a dark grayish brown to dark-brown silt loam about 18 inches deep. This passes gradually into a subsoil of the same color and usually clay loam texture. The soil is rather friable, contains a good supply of organic matter, is retentive of moisture, and is easily cultivated.

Large areas of this type are found in Potter Valley, an area of some size is located at Ukiah, and a fair-sized area in Knights Valley. In Potter Valley and Knights Valley the type comprises a large part of the basin in the center of the valley. The surface is nearly level and in general smooth. The type is well suited to irrigation, both on account of its low position and character of surface.

The Yolo silt loam is a productive, highly prized soil, well suited to a wide range of crops. Most of it is devoted to the production of grain. There are a few hop fields in Potter Valley. The soil is well suited to alfalfa, and this crop is grown extensively.

Yolo silt loam, stream-bottom phase.—The soil of the stream-bottom phase of the Yolo silt loam, which is indicated upon the soil map by crosslines over the Yolo silt loam color, is a brown or dark-brown silt loam 1 to 2 feet deep. The subsoil is similar to the surface soil, but usually somewhat lighter in color. In a few places a compact or partially cemented stratum is encountered at depths of 4 or 5 feet. Occasionally near the bluffs or in slight depressions the type has a silty clay loam subsoil. In places some iron concretions about the size of buckshot are present, and in poorly drained spots the subsoil is sometimes stained with iron. The color of the surface when quite dry is often light grayish brown. The type is loose and friable in structure, is easily cultivated, and has a good supply of organic matter.

This is one of the most important and valuable soils in the area. It is distributed through the flood plain of the Russian River, in places occupying the entire plain though in others it adjoins the bordering bluffs and is separated from the river by the stream-bottom phase of the Yolo fine sandy loam. The type is level and smooth,

and is well suited to irrigation. Drainage is almost invariably good, except during annual overflows.

The Yolo silt loam, stream-bottom phase is in a high state of cultivation. Many hop fields are found on it and alfalfa also is grown extensively. Grain is grown in a few places, but the soil gives so much larger returns when devoted to other crops that the acreage in grain is steadily decreasing. The most successful orchards of prunes and pears near Ukiah are found on this phase. It seems well suited to both these fruits. There is a home orchard of apples over 60 years old on this soil in Redwood Valley, which is very thrifty and bears regularly.

Results of mechanical analyses of samples of soil and subsoil of the stream-bottom phase follow:

Mechanical analyses of Yolo silt loam, stream-bottom phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573016	Soil	0.0	0.2	0.2	3.0	13.5	62.0	21.3
573017	Subsoil	.2	.8	.6	4.5	21.0	48.6	24.2

YOLO SILTY CLAY LOAM.

The soil of the Yolo silty clay loam is a brown silty clay loam, about 18 inches deep, passing gradually into a subsoil of the same color and of the same or slightly heavier texture. The soil is compact, and its cultivation difficult, the soil clodding if plowed when wet. It contains a good supply of organic matter. There are often thin beds of gravel or strata of material of lighter texture in the subsoil.

This is a type of minor extent. It occurs in small areas well distributed throughout the survey, occupying depressions or poorly drained spots surrounded by lighter members of the same series. The surface is level or basinlike and smooth. The type is not subject to erosion. Drainage is often poor. This type is in grain and pasture. Crop yields are generally good.

Yolo silty clay loam, stream-bottom phase.—The Yolo silty clay loam, stream-bottom phase, is indicated on the soil map by crosslines on the Yolo silty clay loam color. The soil is a brown to dark grayish brown, or dark-brown silty clay loam, from 1 to 2 feet deep. The subsoil is brown to dark brown in color and may be mottled in places with brown iron stains. It consists of a silty clay loam to silty clay. The structure of the soil is rather dense, and the soil when wet is sticky and has a tendency to clod, making cultivation difficult except under proper moisture conditions. The soil has a good supply of organic matter.

This is a much less extensive soil than the stream-bottom phase of the Yolo silt loam, with which it is associated. It occupies basins or depressions within the larger areas of the silt loam, evidently where the movement of the water is slow and the clay has opportunity to settle. It is mapped in a few small areas near Ukiah. It occurs also in a number of strips too small to be shown separately on the map. In grain fields in the spring the white meadow foam is very abundant, and this growth largely distinguishes the areas of this type from the adjoining stream-bottom phase of the Yolo silt loam. The surface is level and smooth. Drainage is fair to poor. The areas are well adapted to irrigation.

This phase is used for the same crops as the adjoining silt loam. It occurs in such small areas that its crop adaptation has not been definitely determined, though it apparently is not so well suited to hops as is the silt loam. It seems well suited to alfalfa where the drainage is adequate. One pear orchard, situated both on this phase and on the silt loam, gives better returns on the heavier type. A large part of the phase is in grain. It is a very rich, productive soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Yolo silty clay loam and of the stream-bottom phase:

Mechanical analyses of Yolo silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573018	Soil	1.0	2.6	1.7	8.3	14.2	47.4	24.6
573019	Subsoil	1.7	3.2	2.2	11.3	14.1	44.6	23.0
Stream-bottom phase:								
573014	Soil	.1	.2	.2	1.4	5.2	65.5	27.4
573015	Subsoil	.6	2.2	1.8	7.4	13.4	46.4	28.6

TEHAMA SERIES.

The Tehama soils are prevailingly grayish yellow or brownish yellow. They occupy recent gently sloping to nearly level, smooth alluvial fans formed by intermittent streams. The material is derived from a variety of rocks, in the Ukiah area apparently coming largely from sedimentary and metamorphosed sedimentary rocks.

The Tehama soils are similar in mode of formation to the Yolo soils, but differ from the latter in being lighter in color, a difference due in part to a smaller admixture of organic matter and in part to a difference in the soil materials.

The native vegetation is valley oak, with willow along the stream courses, the growth being scattering. Most of the native covering has been removed.

TEHAMA LOAM.

The soil of the Tehama loam is a light yellowish brown or light grayish brown loam about 2 feet deep, apparently low in organic matter. The subsoil is slightly lighter in color, being yellowish brown or brownish yellow, and consists of a loam or a clay. Some small, rounded gravel is scattered through both soil and subsoil. The soil is evidently mildly acid.

Small areas of this type are scattered throughout the survey. They have a gently sloping, smooth surface and may be subject to erosion in places. Drainage is good, except in the area at Old Hopland.

This type is mainly in grain, to which it seems well adapted. Fruit also does well.

TEHAMA GRAVELLY LOAM.

The soil of the Tehama gravelly loam, which is indicated on the soil map by gravel symbols over the Tehama loam color, is a light yellowish brown or light grayish brown loam, carrying large quantities of gravel. It varies from 18 to 30 inches in depth. This soil has a friable structure and is easy to cultivate. It contains a relatively small quantity of organic matter. The subsoil is light yellow or yellowish brown to grayish brown and is often mottled with gray. It is a gravelly loam to a gravelly clay loam in texture.

Small areas of this type are found well distributed throughout the survey, generally occurring well back against the hills at the edge of the valley. The type is gently sloping and has a smooth surface. Erosion as a rule is not active. The drainage is good, except in some shallow sloughs. The type is fairly well suited to irrigation.

This soil is mainly in grain, but some fruit has been set out in places. Apparently it is well adapted to fruit culture.

TEHAMA SILT LOAM, POORLY DRAINED PHASE.

The soil of the Tehama silt loam, poorly drained phase, is a light-gray to grayish-yellow silt loam, with low organic-matter content and about 2 feet deep. The subsoil is a light-yellow or yellow mottled with gray clay loam. The soil and subsoil often have rusty iron stains. The soil is sticky and difficult to cultivate. It is apparently slightly acid.

Two small areas of this soil are found in the western part of Potter Valley. They are level, have a smooth surface, and occupy poorly

drained depressions. They are used for pasture and the production of grain. One of the areas has considerable salt grass, indicating the presence of alkali. This is the only indication of alkali in the survey. One small area is mapped in the Calpella Valley, across the river from and east of Calpella. It occupies a bench some distance above the river and apparently consists of recent alluvial-fan material, derived from the Pinole soils. It has a sloping surface and is mainly uncleared.

Because of their small extent a few small areas of Tehama fine sandy loam, poorly drained phase, north of Ukiah are included with the poorly drained phase of the silt loam type. The soil ranges from 1 to 2 feet in depth and is underlain by a loam to clay loam subsoil, which is light yellow, mottled with gray. Both soil and subsoil contain some small, rounded gravel, but not enough to affect the texture.

A part of the fine sandy loam type is in grain and a part in vineyards, and the remainder is being set to prunes and pears.

Honcut Series.

The surface soils of the Honcut series, as recognized in previous surveys, are brown to reddish brown in color, and the subsoils generally similar to the surface soil in color, texture, and structure. They consist of recent alluvial-fan deposits, with phases occupying flood plains or lower terraces. The soil materials are derived from a wide variety of rocks, though largely from quartz-free igneous and metamorphic or altered basic igneous rocks.

In this survey only small areas of a red phase of this series are mapped. These, owing to their departure from the typical Honcut soils in color, would, if more extensive, be classified in a new series. The soil is brownish red to rusty red or dark red in color, and is underlain by a subsoil of the same color but usually of heavier texture. The topography is gently sloping to nearly level, and the surface is smooth. These small areas form local alluvial-fan deposits of material eroded from areas of the Aiken soils. They were originally covered with a good growth of fir, oak, and smaller plants, practically all of which have been removed.

Honcut loam, red phase.

The surface soil of the Honcut loam, red phase, is a yellowish-red or dark-red loam about 2 feet deep. It is friable and is easily cultivated, and contains a fair percentage of organic matter. The subsoil is of the same color, a clay loam in texture, and usually passes into very compact material at depths less than 6 feet. Both soil and subsoil contain small quantities of subangular to rounded gravel.

This type is mapped in a few small areas in the southern and central parts of the survey, forming small fans at the base of the hills bordering the valley. The surface is sloping and smooth, though in places subject to erosion. Drainage is good.

The Honcut loam, red phase, is a productive soil. It has been used for the production of grain, but vineyards and orchards are being set out. It seems well suited to fruit growing.

HONCUT GRAVELLY LOAM, RED PHASE.

The soil of the Honcut gravelly loam, red phase, is a dark-red or brownish-red loam, containing considerable small, angular to rounded gravel. It is from 18 to 24 inches deep, is friable and easy to cultivate, and contains a fair percentage of organic matter. The subsoil, a gravelly clay loam, becoming very compact in the lower part, is very similar to the soil in color. This soil is indicated upon the soil map by gravel symbols in the Honcut loam color.

Several small areas of this phase are mapped near Hopland. They are sloping, have a smooth surface, and are well drained. Erosion is active in places. Grain, orchard fruits, and grapes are produced. The type is quite productive and is apparently well suited to fruit growing.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Honcut gravelly loam, red phase:

Mechanical analyses of Honcut gravelly loam, red phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573054	Soil	5.4	6.6	3.8	10.9	9.4	43.2	20.9
573055	Subsoil	11.0	17.6	9.4	17.2	5.8	14.8	24.2

DUBLIN SERIES.

The soils of the Dublin series are dark gray to black. The subsoil is dull yellow to yellowish brown or grayish brown in color and usually lighter in texture than the surface soil. There is, however, little uniformity either in the color or texture of the subsoil and substratum, which consist of alternate layers of clay, silt, and loam, with an occasional bed of gravel at lower depths.

The surface of these soils is nearly level and smooth. A few areas have a gently sloping surface. The native vegetation, which has nearly all been removed, consisted of oak and willow, with some underbrush.

The Dublin soil occurs typically on alluvial fans, and, as mapped in this survey, many of the areas, especially those in Potter Valley, occupy low, broad basins which have only recently been drained. They occur in the extreme outer edge of the low, broad fans and differ in their topography and drainage from areas of the other alluvial-fan soils. The soil evidently owes its black color to the high organic matter and lime content. This dark color distinguishes the series from the other water-laid soils of the area.

DUBLIN CLAY.

The surface soil of the Dublin clay is a dark-gray to black clay from 1½ to 4 feet deep, carrying much organic matter, heavy and sticky when wet, and inclined to crack when dry. The subsoil is lighter in color than the soil, being brown, gray or yellowish gray. It varies in texture from a clay loam to clay and in places contains layers of gravelly material. Strata differing in color and texture are encountered at varying depths, and as the lower depths are reached the gravel content increases. The color of the Dublin clay when dry and powdered is considerably lighter than under normal moisture conditions. In a few places the soil is stained with iron and has a rusty color and is mottled with light gray or yellow. It is a very difficult soil to cultivate, forming clods unless plowed and cultivated under proper moisture conditions.

The areas of this type are level or basinlike and in one case gently sloping. Several areas are mapped in Potter Valley. Here the soil occupies shallow basins. A small area occurs on the lands of the Mendocino State Hospital near Ukiah. In this case the type occupies a small basin which has been formed by the building out of the fan of the stream just south of it. The soil in this case is not uniformly a clay, ranging in texture from loam to clay. The small area about 1½ miles north of Hopland is gently sloping, occupying a low fan. The surface is smooth, erosion is not active, and drainage is generally poor. The area on the farm of the Mendocino State Hospital is drained artificially.

This soil is well suited to irrigation. A part of it is uncleared and is used for pasture. Grain is the principal crop on the cleared areas. Some alfalfa is grown and does very well.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Dublin clay:

Mechanical analyses of Dublin clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573034	Soil	0.2	0.8	0.8	6.2	10.4	48.4	33.4
573035	Subsoil	7.2	9.0	4.7	18.9	18.6	27.7	13.7
573036	Lower subsoil.	2.4	2.4	1.0	4.2	6.4	45.8	37.7

MISCELLANEOUS MATERIAL.

RIVERWASH.

Riverwash consists of the sands and gravels in low-lying, flood-swept areas along the Russian River and some of its tributaries. For the most part, Riverwash is devoid of vegetation, but in places there is a growth of willow, cottonwood, and many annual weeds. The land is nonagricultural on account of its topographic position and its coarse texture and leachy nature.

SUMMARY.

The Ukiah area comprises the valleys of the Russian River and its large tributaries within Mendocino County, Cal. The survey covers an area of 303 square miles, or 193,920 acres. It includes several arable valleys and a part of the Coast Range Mountains. The entire drainage is through the Russian River system.

The Ukiah area was settled between 1850 and 1860, the settlers coming largely from the southeastern part of the United States. The townships of Potter Valley, Ukiah, and Sanel, which approximately conform with the area surveyed, have a population of 6,587, according to the 1910 census. The population is predominantly Anglo-Saxon, and is confined mainly to the arable valleys, the settlement of the hill regions being sparse. Ukiah with a population of something over 2,000 is the principal town in the area. Other towns are of local importance as trading centers in the various valleys.

Transportation facilities are furnished by the Northwestern Pacific Railroad. A good system of roads reaches all the arable sections. All the grain and hay produced are sold within the area; the live stock, hops, and fruit are mainly shipped southward to the Bay region.

The climate is mild and is well suited to the production of general farm crops, alfalfa, hops, grapes, and most tree and bush fruits. The Weather Bureau station at Ukiah reports the mean annual temperature as 57.6° F. and the mean annual precipitation as 37.3 inches.

In the early history of this region stock raising was the leading agricultural interest, hay and most of the grain produced being used for feed. At present sheep and cattle are raised in large numbers on the rolling hills bordering the arable valleys. A large number of hogs and horses also are raised. Hops constitute one of the main crops. Wheat is the principal grain crop, closely followed by oats, while barley and corn are grown to a smaller extent. Grapes for wine making are grown extensively, and the production of fruit, although less important than in regions to the south, is receiving increasing attention. Alfalfa is a comparatively new crop, but is rapidly gaining in favor. Irrigation is receiving some attention, although only individual pumping plants have been used so far.

The farms are of medium size, and a few are being subdivided. The best alluvial lands are valued at $200 to $500 an acre, the bench lands at $75 to $200 an acre, and hill lands suitable only for pasture at $5 to $20 an acre. Most of the farms are operated by the owners, but a fair supply of labor is available at reasonable prices.

The residual soils of the area are relatively unimportant agriculturally. They are classed with the Mariposa, Aiken, Olympic, and Climax series, with some areas of Rough mountainous land.

The Mariposa soils are pale yellow to grayish yellow. This series is represented by a single type—the loam. It is of low productiveness and is used for pasture. The Aiken soils are red. The loam and stony loam are recognized in this area. They are productive soils, but are quite limited in extent. The Olympic soils are brown. Only the loam and the stony loam of the series are mapped. They occur in very small areas and are used mainly for pasture. The Climax soils are black. The Climax clay adobe is the only type of this series encountered in the area. Many small areas of this soil are found, and they are mainly in pasture. Rough mountainous land includes most of the hill land bordering the arable valleys on both sides. Most of the hills are covered with residual soils belonging to the series mentioned above, but the soil is shallow and subject to destructive erosion.

Soils derived from old valley-filling material occupy the benches and terraces. They are classed with the Corning, Pleasanton, and Pinole series. The Corning soils are pale red, and the subsoils are heavier in texture than the surface soils. The loam, the gravelly

loam, and the gravelly clay loam types are recognized. The Pleasanton series is represented by a single member, the gravelly loam. This soil is dark grayish brown. It is of fair productiveness. The Pinole soils are pale yellow to light yellowish brown. The sandy loam, the loam, and the gravelly loam are mapped in this area. The gravelly loam is an extensive type of fair productiveness.

The recent alluvial soils occupy fans and stream flood plains. They are classed with the Yolo, Tehama, Honcut, and Dublin series, and the nonagricultural type Riverwash. The Yolo soils are brown to dark brown. The various types encountered, with their stream-bottom phases, are very productive and the most highly prized soils in the area. The Tehama soils are brownish yellow to grayish yellow. The loam and the gravelly loam are mapped, with inextensive areas of phases of the fine sandy loam and silt loam. They are not quite so productive as the Yolo soils. The Honcut soils, as they occur in this survey, are dark reddish brown to dark red. Red phases of two of these types are mapped, the loam and gravelly loam. They occur in small areas. The Dublin series is represented by the clay type. This soil is black. It is a type of minor importance.

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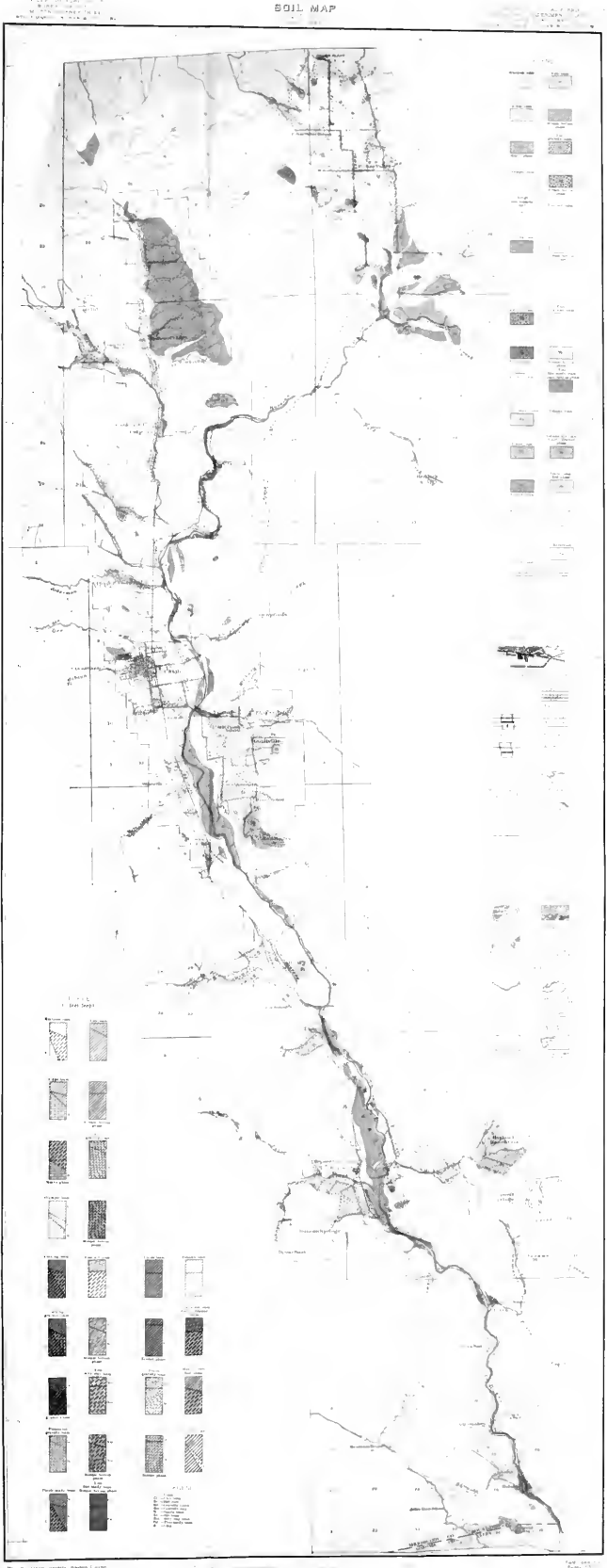
SOIL MAP



[PUBLIC RESOLUTION—No. 9.]

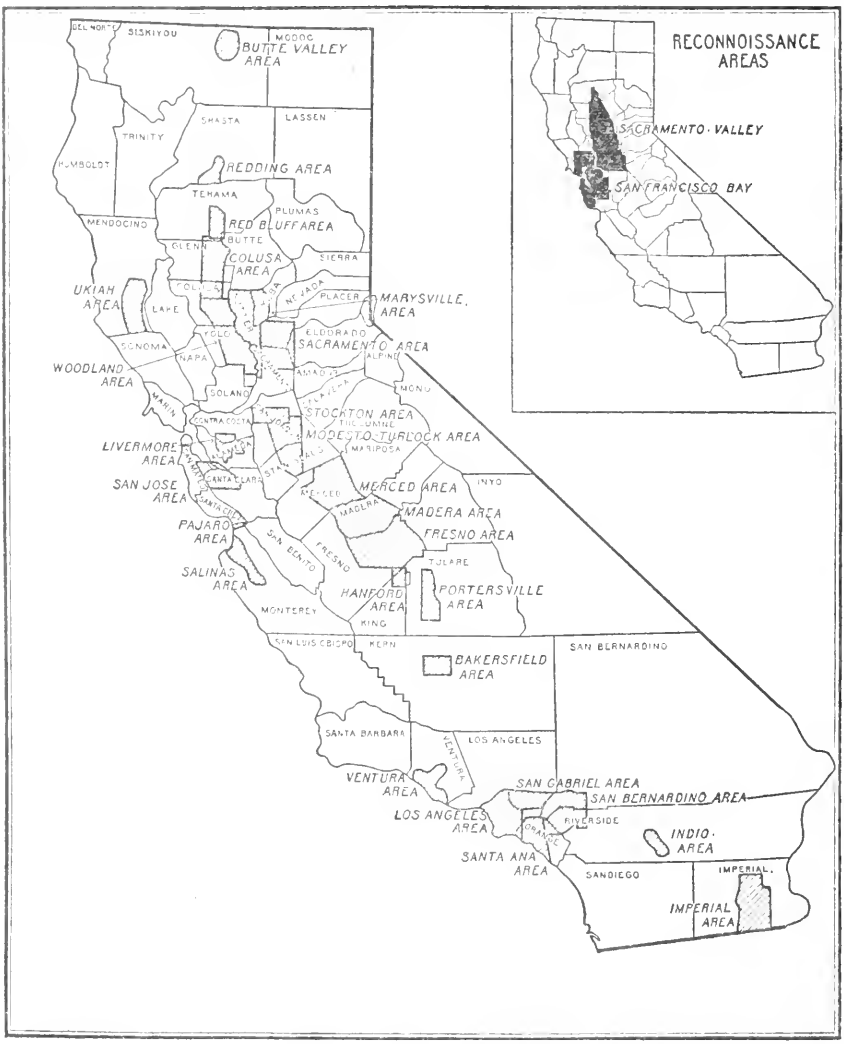
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Map showing areas surveyed in California.